NATURAL MAGNETS AND ARTIFICIAL MAGNETS

NATURAL = LODE STONE

ARTIFICIAL = STEEL - (NICKEL ALUMINUM - COBALT) = ~~AN~~ ALNICO

FLUX TOTAL AMOUNT OF LINES OF FORCE

PERMIABILITY - THE ABILITY OF A SUBSTANCE TO PASS LINES OF FORCE OR CONDUCT MAGNETISM

RELUCTANCE - THE OPOSITION TO LINES OF FORCE. IRON IS 2000 TIMES MORE PERMEABLE THAN AIR.

RETINTIVITY - THE ABILITY TO HOLD MAGNETISIM.

RESIDUAL MAGNETISIM - LEFT OVER MAGNETISIM.

LAWS - LIKE POLES REPELL UNLIKE POLES ATRACT

ELECTROMAGNETISIM

A CONDUCTOR CARRING CURRENT HAS A MAGNE~~TIED~~ FIELD AROUN IT THIS FORCE IS ELECTROMAGNETIC FORCE - IT IS AT RIGHT ANGELS TO THE CONDUCTOR NO POLARITY. LEFT HAND RULE THUMP DIRECTION OF CURRENT.

FIELD IN A COIL. HAS POLARITY - LEFT HAND RULE FINGERS DIRECTION OF CURRENT - THUMP N. POLE.

EFFECTS IN COIL DEPEND IN AMOUT OF CURRENT AND NO OF TURNS. INCREAS. UNIT OF MEASURE IS THE AMPERE-HOURS.

FORMULA

A.H. = CURRENT X TURNS

ELECTRO MAGNET IS A COIL WHITH A IRON CORE ICRESES FIELD

MAGNETO ~~FORCE~~ MOTIVE FORCE IS THE STRENTH OF A MAGNETIVE FORCE AROUND A ELECTROMAGNET = UNIT AMP-HOURS.

INDUCED E.M.F.

INDUCTION IS THE PRODUCTION OF EM.F IN A CONDUCTOR BY CUTING OR BEING CUT BY A MAGNETIC FLUX (RELATIVE MOTION)

3 - FACTORS - 1 - FLUX - 2 - MOTION 3 - CONDUCTOR

3 KINDS OF E.M.F

1. ELECTROMAGNETIC
2 - SELF IDUCTED
3 - MUTUAL INDUCTED

Nº 1- ELECTROMAGNETIC FORCE IS THE PRODUCCION OF AN E.M.F. DUE TO PHISICAL MOTION A CONDUCTOR AND A MAGNETIC FIELD. A-C.

Nº 2- SELF INDUCED IS THE PRODUCTION OF AN E.M.F DUE TO THE CHANGE OF CURRENT IN A CONDUCTOR - 1-CIRCUIT

Nº 3- MUTUAL IS AN E.M.F. SET UP (INDUCED) IN A CIRCUIT BY THE CHANGE OF CURREN IN A ADJACENT CIRCUIT

2-CIRCUITS - MOTION INVISIBLE

IN ELECTROMAGNETIC INDUCTION WE INCRESE E.M.F BY INCRESING THE FACTORS

3- EFFECTS - 1- NUMBER OF CONDUCTORS - 2- STRENGH OF FLUX OR FIELD. 3- THE SPEED OF CONDUCTORS.

LEF HAND RULE FOR GENERATOR = FLUX THRU PALM, THUM DIRECTION OF MOTION, FINGERS POINT DIRECTION OF CURREN

SELF INDUCTANCE E-M-F.

1- CIRCUIT - MOTION INVISIBLE - IS COUNTER INDUCE E.M.F OR BACK EMF OPPOSES

THE APLIED EMF OR LAGING EFFECT OF CURRENT

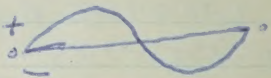
LENZ'S LAW. 1. AN INDUCED VOLTAGE ALWAYS OPPOSES INDUCING (APLIED) EMF.

2. AN INDUCED EMF. ALWAYS OPPOSES ANY CHANGE IN CURRENT

MUTUAL INDUCTANCE - SOME LIKE A TRANSFORMER

A.C.

A.C. IS A CURRENT WHICH PERIODICALLY CHANGES IN DIRECTION AND CONSTANTLY CHANGES VALUE.

SINE WAVE 

INSTANTANEUS VALUE OF A SINE WAVE IS EMF GENERATED AT ANY ISTANT TIME.

MAXIMUM VALUE IS PEAK EMF

EFFECTIVE VALUE IS EQUAL TO THE VALUE OF A D.C WHICH PRODUCES EQUAL HEATING EFFECT

EFFECTIVE VALUE = MAXIMUM VALUE X .707 - PRODUCT IS LESS THAN MAXIMUN VALUE

PULSATING D.C (P.D.C) IS A D.C COMPONENT OF A.C CHANGING IN VALUE - ONE DIRECTION

ONE ALTERNATION - HALF CYCLE. 180° + OR - ONE CYCLE - 2 ALTERNATIONS 360°

FREQUENCY IS NUMBER OF CYCLES PER SECOND OF A COIL. PHASE IS THE DIFFERENCE IN TIME BETWEN ANY ~~POINT~~ POINT IN A CYCLE AND THE BEGINING OF THAT CYCLE

GENERATORS

GENERATOR IS A MACHINE WHICH CHANGES MECHANICAL ENERGY INTO ELECTRIC ENERGY. IN RELATIVE MOTION BETWEEN CONDUCTOR AND FIELD ELECTROMAGNET, YOKE, FIELD COIL - IN A.C USE COLECTOR RINGS OR SLIP-RING IN D.C (COMMUNTADOR) AND BRUSHES ~~PATH~~ PATH SLITS)

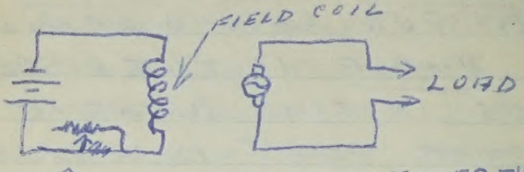
FREQUENCY DEPENS IN SPEED OF ARMATURE AND NUMBER OF POLES. TYPES - SELEFEXCITED - EXTERNALY EXCITED

SHUNT GENERATOR OUTPUT VOLTAGE CONECTED ACROSS FIELD COIL

SERIES OUTPUT CONNECTED IN SERIES WITH FIELD COIL.

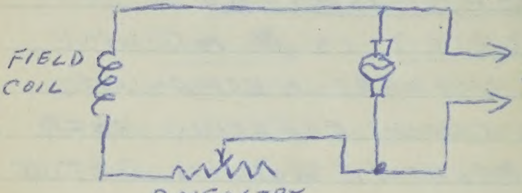
COMPOUND HAS BOTH SERI
AND SHUNT FIELD IN SAME
POLE- SERIES TO AID OR OPPOS

SHUNT FIELD

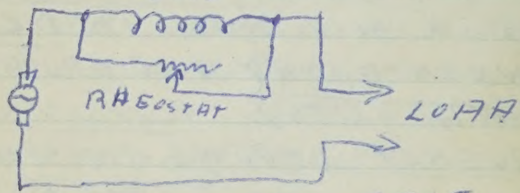


SHUNT EXTERNALLY EXCITED
~~SUNT~~

BEST

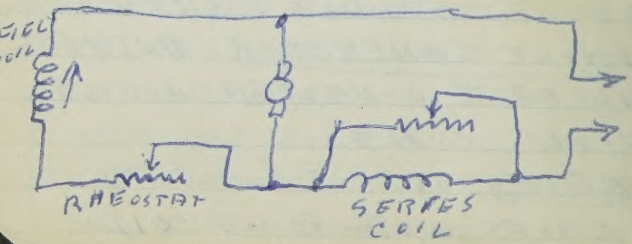


SHUNT SELF EXCITED



SERIES SELF

COMPOUND



MOTORS

MOTORS CONVERT MECHANICAL ENERGY INTO ELERTRICAL
PHISICALY SAME AS GENERATOR
TORQUE IS THE TURNING FORCE - SHUNT - SERIES COMPOUND - ~~#~~ SHUNT WOUND GOOD TORQUE - CONSTANT SPEED
SERIES WOUND STRONG TORQUE GOOD TO START HEAVY LOAD IF IT IS REMOVE.

INDUCTANCE

IS THE ABILITY OF MAGNETIC FIELD TO OPOSE ANY CHANGE IN CURRENT FLOW - SYMBOL "L"
CUTTING ACTION OF MAGNETIC FIELD - OPPOSITION COUSED BY ~~CMF~~ CEMF. SELF INDUCED VOLTAGE. A COIL IS CALLED INDUCTOR =

AIR CORE

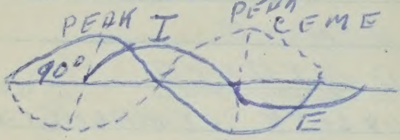
RATE OF FLUX CUTTING
MAGNITUD OF INDUCED EMF
DEPENDS IN 4 PHISYCAL FACTORS = I - SIZE A NUMBER OF TURNS OF WIRE - II - DISTANCE BETWEN TURNS. III - DIAMETOR OF CORE. IV TYPE OF CORE
PRACTICAL TO CHANGE - UNIT OF INDUCTANCE = L = HENRY = h
MILIHENRY = mh = .001.

1h = ONE INDUCED VOLT TO STOP ONE AMP IN ONE SECON

D.C. INDUCTIVE CIRCUIT W

PASS D.C. WITH NO CEMF.

A.C. INDUCTIVE CIRCUIT. THE CEMF WILL BE GREATER AT START OF CURRENT CAU-SED BY THE CUTTING FORCE OF FLUX. CURRENT STARTS A A 90° LAG.



INDUCTIVE REACTANCE A REA-TANCE IS THE OPPOSITION TO I FLOW WHICH WILL NOT CONSU POWER - THE UNIT Ω SYMB 'X' INDUCTIVE REACTANCE "X_L"

NO "X_L" IN D.C. - IN P.D.C "X_L" IN A.C. COMPONENT. AN INDUC-TOR IN A P.D.C. WILL SMOTH THE CURRENT. - FORMULA FOR "X_L"

$X_L = 2\pi F L$

X_L = INDUCTIVE REACTANCE IN Ω

$2\pi = 6.28$

F = FREQUENCY IN CYCLES PER SECO

L = INDUCTANCE IN HENRYS

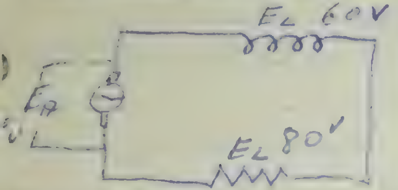
IF WE LOOK FOR "L"

$L = \dfrac{X_L}{2\pi F}$ / $I = \dfrac{E}{X_L}$

IN A PURE RESISTANCE CKT "E" AND "I" ARE IN PHASE

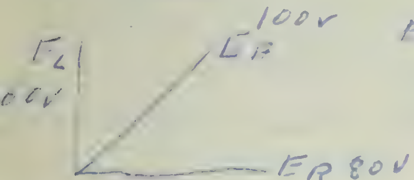
IN A PURE INDUCTIVE CKT "E" AND I ARE 90° OUT OF PHASE

SERIES L-R CIRCUITS



$\left(X_L = \sqrt{Z^2 - R^2} \right.$ SUBSTITUTING $\left. \right)$

E AND I ACROSS R IN PHASE
E AND I " L 90° OUT
CURRENT EVERYWHERE SAME
FORMULA



$E_A = \sqrt{E_L^2 + E_R^2}$

$\sqrt{10000} = E_A$ 100

60 X 60 = 3600
80 X 80 = 6400
10,000

100 X 100 = 10,000

INDUCTIVE REACTANCE AND RESISTANCE = IMPEDANCE

IMPEDANCE IS THE TOTAL OPPOSITION OF R and L (RESISTANCE AND REACTANCE) IN A CIRCUIT
UNIT Ω SYMBOL - Z

VOLTAGE ACROSS ~~RESISTANCE~~ INDUCTOR =
$E_L = I X_L$

VOLTAGE ACROSS RESISTANCE

$E_R = IR$ // $E_A = I_T R$

$E = \sqrt{E_R^2 + E_L^2}$ // $E = \sqrt{(IR)^2 + (I...}$

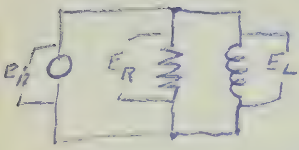
$IZ \sqrt{I^2(R^2 + X_L^2)}$ // ~~IZ~~

$Z = \sqrt{R^2 + X_L^2}$ IN SERIES

OHMS LAW FOR A.C CKTS

$I = \frac{E}{Z}$ // $E = IZ$ // $Z = \frac{E}{I}$

PARALELL ~~R~~ L-R CKTS



ER - EL = EA IN PALALEL CKTS

I - IN R IN PHASE WITH E -

I IN L 90° OUT OF PHASE

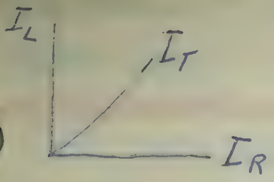
TOTAL $I = \sqrt{I_R + I_L}$

I_R AND I_L 90° OUT OF PHASE

TOTAL IMPEDANCE IN A PARALL... CKT = $Z_J = \frac{R \cdot X_L}{\sqrt{R^2 + X_L^2}}$ OR PRODUCT OVER SUM

OR BY OHMS LAW.

$Z_J = \frac{E_A}{I_T}$



$$I_T = \sqrt{I_L + I_R}$$

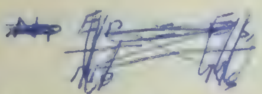
VOLTAGE SUBSTITUTION

TRANSFORMERS

MUTUAL INDUCTANCE

A TRANSFORMER IS AN ELECTRIC DEVICE WHICH TRANSFERS ELECTRICAL POWER FROM ONE CKT TO ANOTHER BY MEANS OF MUTUAL INDUCTION. CONSISTS OF TWO COILS PRIMARY AND SECONDARY AND A CORE

TURNS RATIO - MAGNITUD OF EMF DEPENDS ON No OF TURNS IN SECONDARY



E AN I RATIO WITH N RATIO

$\frac{N_s}{N_p} = \frac{E_s}{E_p}$ TURNS RATIO = VOLTAGE RATIO

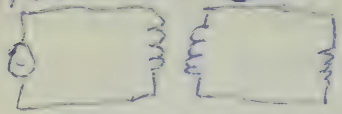
CURRENT RATIO SAME BUT INVERSE $= \frac{N_s}{N_p} = \frac{I_p}{I_s}$

RATIO RELATIONSHIP

STEP UP TRANSFORMER

RATIO $\frac{N_s}{N_p}$ - STEPDOWN $\frac{N_p}{N_s}$

110V 2:1 220V



RATIO 2:1 STEP UP "E"

RATIO 1:2 STEP DOWN "I"

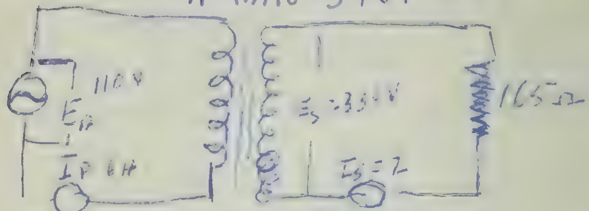
POWER EQUAL - $P_p = P_s$

POWER = EI OR ~~$\frac{E^2}{R}$~~

$P_p = E_p I_p$ // $P_s = E_s I_s$ THEN

$E_p I_p = E_s I_s$

N-RATIO - 3 TO 1 STEP-UP



$P_p = 660$ $P_s = 660$

TURNS RATIO; IMPEDANCE

IMPEDANCE RATIO ACROSS A TRANSFORMER = THE SQUARE OF TURNS RATIO.

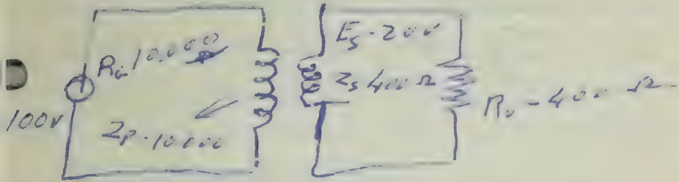
$Z = N^2$ // $N = \sqrt{Z}$ RATIO

N-RATIO	Z RATIO
$9:1^2$	= 81 : 1
12:	= $\sqrt{144}$: 1

~~Imped~~ IMPEDANCE MACHING

~~Resis~~ RESISTANCE FROM SOURCE AND LOAD MACHING

FOR MAXIMUM TRANSFER OF POWER IN ANY CKT, THE IMPEDANCE OF THE LOAD MUST EQUAL OR MATCH THE INTERNAL IMPEDANCE OF THE SOURCE



$$\left(\frac{N_P}{N_S}\right) = \sqrt{\frac{Z_P}{Z_S}} = \sqrt{\frac{10,000}{400}} =$$

$$= \sqrt{\frac{25}{1}} \quad \frac{N_P}{N_S} = \frac{5}{1} \text{ TURNS RATIO}$$

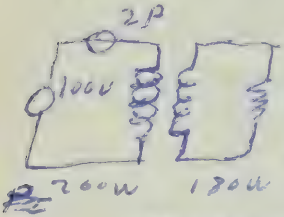
TRANSFORMER LOSSES: EFFICIENCY

EFFICIENCY OF TRANSFORMER DEPENDS IN FOUR FACTORS OF LOSSES - 1 - COPPER LOSS. 2 - HYSTERISIS - 3 - EDDY CURRENT 4 - FLUX LEAKAGE

1 - COPPER LOSS IN RESISTANCE OF COIL - USE LARGER WIRE POSIBLE. 2 - HYSTERISIS - POWER LOSS IN TRANSFORMER CORE OVERCOME BY USING CORE OF

SILICON STEEL - LOW HYSTERESIS LOSS. 3 - EDDY CURRENTS EMF INDUCED IN CORE - OVERCOME BY LAMINATING THE CORE AND INSULATING THEM. 4 - FLUX LEAKAGE ARE FLUX LINES LOST IN THE AIR.
HIGH FREQ. MORE HYSTERESIS AND EDDY CURRENTS.
LOSS % OF EFFICIENCY =

$\frac{OUTPUT}{INPUT} \times 100$



~~P = E/I~~ P = EI

100 x 2 = 200 W

$\frac{180}{200} \times 100 = 90\%$ EF

CAPACITANCE - CAPACITOR

CAPACITANCE THE ABILITY TO STORE ELECTRICAL ENERGY

CAPACITOR IS A DEVICE HAVING ABILITY TO STORE ELECTRICAL ENERGY. COMPOSE OF PLATES AND DIELECTRIC. SYMBOL "C" UNIT THE "FARAD" "F" MICROFARAD, MICROMICROFARAD μf $\mu\mu f$ - FACTORS TO CAPACITANCE. 1. - AREA OF PLATES 2 - DISTANCE BETWEEN PLATES 3 - TYPE OF DIELECTRIC

MATHEMATICS

POWERS OF TEN

EXPONENT IS THE NUMBER FOUND IN THE UPPER RIGHT HAND CORNER OF A NUMBER WHICH INDICATES HOW MANY TIMES THAT NUMBER IS TO BE MULTIPLIED BY ITSELF

$3^2 = 3 \times 3$ /// $10^2 \times 10^2 = 10^4$

WHEN MULTIPLYING PLUS EXPONENTS ADD - $10^2 \times 10^2 = 10^4$

MULTIPLYING MINUS EXPONENTS SUBTRACT = $10^{-5} \times 10^{-2} = 10^{-3}$

WHEN MULTIPLYING UNLIKE EXPONENTS - SUBSTRACT AND KEEP THE SIGN OF LARGER NUMBER

$10^{-2} \times 10^4 = 10^2$ // $10^{-7} \times 10^3 = 10^{-4}$

WHEN DIVIDING BRING UP NUMBER AND CHANGE SIGN.

$$\frac{10 \times 10^6}{5 \times 10^2} = \frac{10 \times 10^6 \times 10^{-2}}{5} =$$

$$\frac{10 \times 10^4}{5} = \frac{10}{5} = 2 \text{ TO } 10^4 \text{ ADD}$$

FOU ZEROS

SO 20,000

MINUS

$$\frac{6 \times 10^2}{3 \times 10^6} = \frac{6 \times 10^2 \times 10^{-6}}{3} =$$

$$= \frac{6 \times 10^{-4}}{3} = \frac{6}{3} = 2$$ ADD 4 MINUS PLACES ~~ZEROS~~

.0002

WHEN $\sqrt{\ }$ WHITH EXPON

DIVIDE EXPONENTS BY TWO

$\sqrt{10^6} = 10^3$

$\sqrt{25 \times 10^8} = \sqrt{25}$ 5

$8 \div 2 = 4$ so $\sqrt{25 \times 10^8} = 5 \times 10^4$

$\sqrt{25 \times 10^7} = \sqrt{25 \times 10 \times 10^6} =$

~~$\sqrt{25} = 5$ $6 \div 3 =$~~

$= \sqrt{250 \times 10^6} =$

$350,000,000 \times .00005 =$

$(35 \times 10^7) \times (5 \times 10^{-5}) = 35 \times 5 = 17$

$175 \times 10^2 = 17500$

MEGA $= 1 \times 10^6$

KILO $= 1 \times 10^3$

MILLI $= 1 \times 10^{-3}$

MICRO $= 1 \times 10^{-6}$

MICROMICRO $= 1 \times 10^{-12}$

$X_L = 2\pi F L = 6.28 \times (5 \times 10^6) \times$

$F = 5$ Mc $\qquad \times (8 \times 10^{-3})$

$L = 8$ mh $\qquad 5 \times 80 = 40 \times 6.28 = 251.20$

$251.20 \times 10^{+3} = \underline{251,200}$

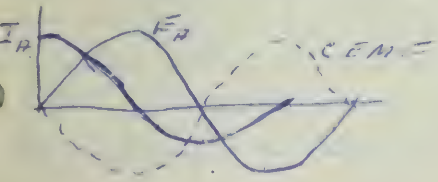
DIELECTRIC CONSTANT "K"

DIELECTRIC CONSTANT IS A RATING
IVEN TO THE DIELECTRIC BASED
AGAINST AIR WHICH IS "1"
AIR - 1 - GLASS 6 TO 1 BETTER
GLASS 6 - MICA 7 " " "
MICA ?

A CAPACITOR IS AN OPEN CIR-
UIT TO D.C. AND CLOSE TO A.C.
WORKING VOLTAGE IS THE SAFE
VOLTAGE WHICH THE CAPACITOR
WILL OPERATE.

PHASE SHIFT

N A CAPACITANCE CKT THE CU-
RENT LEADS THE VOLTAGE BY
90° — CURRENT FLOW THE MAXI
UM INSTANTANEOUSLY.



CAPACITANCE REACTANCE

IS OPPOSITION TO CURRENT CAU-
E BY CAPACITANCE SYMBOL
"X_C" UNIT "Ω" - FORMULA

$$X = \frac{1}{2\pi FC} = \frac{1}{6.28FC} = \frac{.159}{FC}$$

INCREASE F OR C REACTANCE DE
CREASES - CURRENT INCREASES

~~SERIES R-C CKTS~~

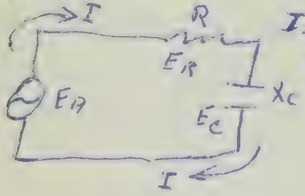
CAPACITANCE - RESISTANCE - IMPEDANCE → REACTANCE

THE IMPEDANCE OF AN R-C CKT IS THE SQUARE ROOT OF THE VICTORIAL SUM OF THE SQUARES OF RESISTANCE AND REACTANCE.

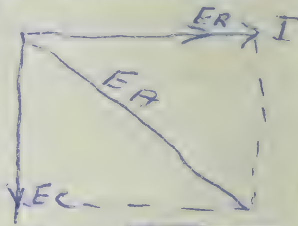
$$Z = \sqrt{R^2 + X_C^2}$$

IN SERIES R-C CKTS

THE CURRENT IS ALLOVER. THEA SAME - IN RESISTANCE IN FACE WHITH E - IN X_C 90° OUT OF PHASE WHITH E



$$I = \frac{E}{Z}$$

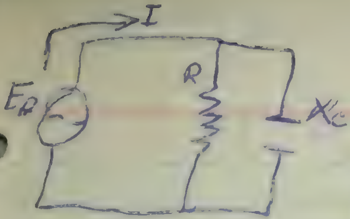


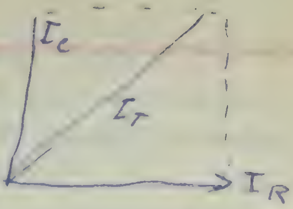
$$E_A = \sqrt{E_C^2 + E_R^2} \qquad Z = \sqrt{R^2 + X_C^2}$$

IN PARALLELL CKTS THE CURRENT IS 90° OUT OF PHASE IN THE R AND X_C = $I_T = \sqrt{I_R^2 + I_C^2}$

$$Z = \frac{E}{I_T} \quad \text{OR} \quad Z = \frac{R \cdot X_C}{\sqrt{R^2 + X_C^2}}$$

CURRENT MORE THAN IN EITHER
IMPEDANCE IS LESS





CAPACITORS IN SERIES AND PARALLEL - TOTAL CAPACITANCE IN SERIES IS SAME FORMULA THAN RESISTORS IN PARALLEL

$$C_T = \frac{C_1 * C_2}{C_1 + C_2}$$

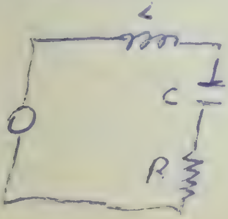
IN PARALLEL IS SAME AS RESISTANCE IN SERIES

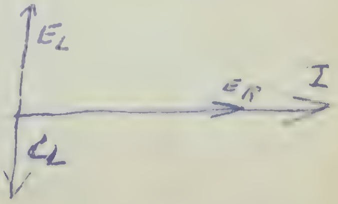
$$C_T = C_1 + C_2 + C_3$$

L-C-R CKTS (SERIES)

IN SERIES L-C-R CKTS THE VOLTAGES ACROSS "L" AND "C" ARE 180° OUT OF PHASE "I" IS CONSTANT -

VECTOR:





$$E_A = \sqrt{E_R^2 + (E_L - E_C)^2}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

THE VOLTAGE ACROSS A SINGLE REACTIVE ELEMENT CAN HAVE A GREATER EFFECTIVE VALUE THAN THE E_A.

$E_L = I \cdot X_L$ - $E_C = I \cdot X_C$

IF THE CKTS X_L IS GREATER THAN X_C IT IS IDUCTIVE.

IF X_C IS GREATER IS CAPACITIVE

IF $X_L = X_C$ IT IS IN RESONANCE AND VOLTAGE AND CURRENT IN PHASE AND $Z = R \div E_C = E_L$ AND "I" IS AT MAXIMUM - THE "E" DROPS IN THE REACTIVE ELEMENTS ARE MAXIMUM AND EQUAL AND CAN BE GREATER THAN "E_A"

FREQUENCY IN A RESONANT CKT IS FOUND BY $F = \frac{1}{2\pi\sqrt{LC}}$

$F = \frac{.159}{\sqrt{LC}}$

A CKT IN RESONANCE MINIMUM IMPEDANCE - ON EITHER SIDE OF RESONANCE - "I" IS LOW AND Z IS ~~HIGH~~ LOW

$X_C << X_L$ - CAPACITANCE

$X_L <<$ - IDUCTIVE

R - RESISTIVE

SERIES TUNED CKTS

FREQUENCY IN RESONANCE DEPENDS IN L AND C ALL OTHER FACTORS ARE CONSTANT.

A SERIES TUNED CKT IS ONE IN WHICH THE VOLTAGE IS ORIGINATED WITHIN ITSELF.

CHARACTERISTICS.

1- I IS EQUAL IN ALL PARTS

2- $E_A = \sqrt{E_R^2 + (E_L - E_C)^2}$

3- E_L LEADS I BY 90°

4- E_C LAGS I BY 90°

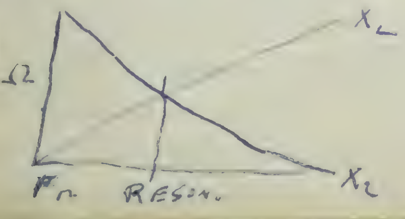
5- E_C AND E_L ARE 180° OUT

$E_C = E_L$; $X_C = X_L$; $X = 0$

$Z = R$ AT RESONANCE OR TUNED $L \times C$ MUST BE SAME

AT RESONANCE I MAXIMUM Z MINIMUM.

IF F_r INCREASES AT RESONANCE X_L INCREASE X_C DECREASES SAME RATIO



NOT RESONANCE

IF F_r INCREASES X_L INCREAS X_C DECRE.

F_r DECR. X_L DEC- X_C INC.

F_r - IN EITHER SIDE OF RESONANCE Z GREATER & I LOWER.

RESONANT F_r.

"C" INC- F_r DEC. X_C DEC -

"C" DEC F_r INC X_C INC

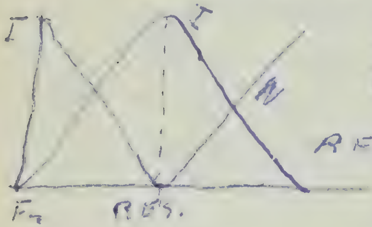
"L" DEC - F_r. INC. X_L

"L" INC - F_r DEC. X_L

SO IF L OR C INC. F_r DEC

AND F L OR DEC - F_r INC

RESONANCE CURVE



I - HIGH

Z - LOW

RESPOND CURVE

SELECTIVITY

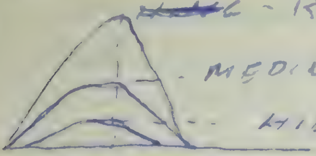
SESITIVITY

SENSITIVITY IS A DEGREE OF RESPOND THAT A TUNE CKT HAS FOR A WEAK SIGNAL. OR THE RESPOND CURVE. HOW HIGH DEPENDS IN I

SELECTIVITY IS THE ABILITY TO SELECT ONE F_r AND REJECT ALL OTHERS. THE WITH OF THE SLOPE DETERMINES THE SELECTIVITY. THE STIFEST

THE SLOPE THE MORE SE-
LECTIVITY:

THE RESPONSE CURVE
DEPENDS ON RESISTANCE.
THE MORE 'R' THE LESS 'I'
& THE LOWEST THE CURVE



"Q" OF A SERIES CKT

"Q" IS THE QUALITY OF A TUNED CKT OR THE MEASURE OF "E" GAIN OR THE RATIO BETWEEN E_A AND E_L OR E_C.

$$"Q" = \frac{E_L}{E} = \frac{X_L}{R}$$

Q IS THE MEASURE OF SELECTIVITY, THE LOWER THE "R" THE HIGHER THE Q.

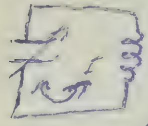
BANDWIDTH

IS THE AMOUNT OF CYCLES ABOVE AND BELOW RESONANT Fr. THAT CAN BE RECEIVE BY A TUNED CIRCUIT

$$B_W = \frac{F_r}{Q}$$

PARALLEL TUNED CKTS

A PARALELL RESONANT CKT IS ONE IN WHICH THE SIGNAL IS ORIGINATED OUTSIDE THE CKT. A TANK CKT IS IS USED AS A TERM FOR SERIES OR PARALELL CKTS TUNED, AND IT MEANS THE ABILITY TO STORE ENERGY.



A PARALLEL CKT IS IN RESONANCE IF

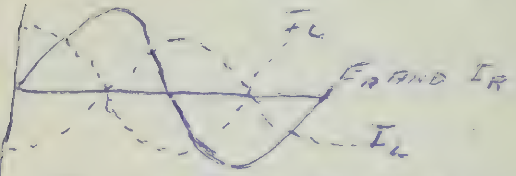
$X_C = X_L$

IN PARALLEL E_A IS EQUAL IN ALL BRANCHES AND

I_C LEADS E BY 90°

I_L LAGS E BY 90°

I_L AND I_C 180° OUT OF PHASE



$I_C = \frac{E}{X_C}$; $I_L = \frac{E}{X_L}$

$I_X = \begin{pmatrix} I_L - I_C \\ I_C - I_L \end{pmatrix}$ $\quad I_T = \sqrt{I_R^2 + I_X^2}$

I_L AND I_C CAN BE GRATER THEN I_T $\quad Z = \frac{E}{I_T}$

THE CKT WILL ACCORDING TO THE CURRENT FLOW

IN THE BRANCHES THUS IF
I_C IS GREATER X_C WILL BE
LOWER AND THE CKT CAPACITI
VE, AND THE OPPOSITE IF
IT GETS INDUCTIVE.

IN THE RESONANT CKT X_C
AND X_L ARE EQUAL AND
I_C AND I_L EQUAL SO THE
CKT IS RESISTIVE

THE RESONANT FREQUENCY
EQUALS $F = \frac{.159}{\sqrt{L \cdot C}}$

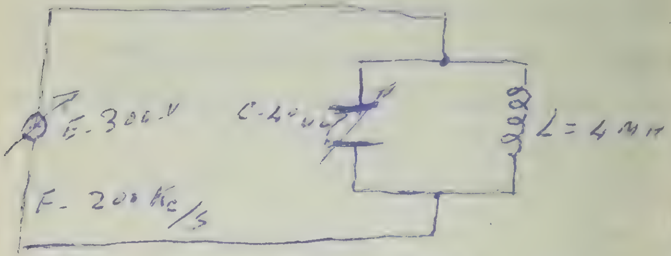
SOMETIMES CALLED ANTI-RE
SONANT F.

AT RESONANCE F. I_C AND I_L
CANCEL EACH OTHER SO I_x IS "0"
THE LINE CURRENT IS AT
MINIMUM - THE TANK CURRENT AT
MAXIMUM AND THE IMPEDANCE
IS MAXIMUM.

IN EITHER SIDE OF RESONAN-
CE THE I_{LINE} IS GREATER, THE
Z IS LOWER. AT HIGH FR.
X_L HIGH AND X_C LOW, AT
LOW F. X_C GREATER X_L LOWER
AND Z LOW. THE I_{TANK}
IS CALLED OSCILATING I
AND IT MOVES FROM "1" TO "2"
AND BACK CONSTANTLY.

I_{TANK} MAXIMUM I_C OR I_L; I_{LINE} MINIMUM. Z MAXIMUM CKTS ACTS RESISTIVE. HIGH POWER TRANSFER.

PARALEL CKT



RESONANCE $F_r = \frac{.159}{\sqrt{L \cdot C}}$ SO

$$\frac{.159}{\sqrt{4 \times 10^{-3} \times 4 \times 10^{-11}}} = 398,000 \text{ CPS}$$

$I_L =$

$X_L = 6.28 FL = 6.28 \times 398 \times 10^3 \times 4 \times 1$

$X_L = 10,000\ \Omega$

$I_L = \frac{E}{X_L} = \frac{300}{10,000} = .03\ A$

F_r - 200 Kc

$X_L = 6.28 \times 2 \times 10^5 \times 4 \times 10^{-3} = 5024\ \Omega$

$I_L = \frac{300}{5024}\ .059\ A$

$X_C = \frac{.159}{FC} = \frac{.159}{2 \times 10^5 \times 4 \times 10^{-11}} =$

$= 19,900\ \Omega$; $I_C = \frac{300}{19,900} = .015\ A$

CKT INDUCTIVE

$I_{LINE} = I_C - I_L = .059 - .015 = .044$

$$Z = \frac{X_L \cdot X_C}{X_C - X_L} = \frac{5024 \times 19900}{19900 - 5024} = 6720\ \Omega$$

NOW THEN

$$I_L = \frac{E}{\sqrt{R_T^2 + X_T^2}} \text{ OR } \frac{E}{Z}$$

$$I_C = \frac{E}{X_C} \quad I_T = I_L - I_C$$

DETUNING

TO LOWER FREQUENCY THAN INCOMING F. INCREASE "C" DECREASE X_C; X_L CONSTANT

HIGHER THAN INCOMING ~~FREQ~~ ~~FREQ~~" DECREASE "C" X_C INCR.

PRIME EFFECT OF PARALLEL TUNE CKT IS TO GET MAXIMUM IMPEDANCE AND MAXIMUM I IN THE TANK.

"Q" OF THE PARALLEL CKT IS THE RATIO OF I IN THE TANK TO THE I IN THE LINE

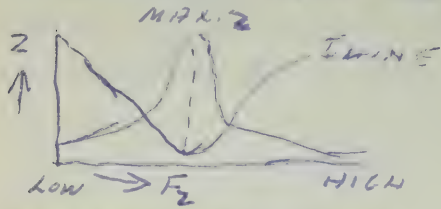
$$Q = \frac{I_T}{I} = \frac{X_L}{R} = \frac{Z}{X_C}) \quad R = \frac{X_L}{Q}) \quad Z = Q \cdot X_L$$

THE MAGNITUDE OF "R" IN THE "L OR C" DETERMINES THE QUALITY OF OR "Q" OF A RESONANT CKT

$$I_C = Q \cdot I; \quad Z = Q \cdot X_L \text{ OR } X_C$$

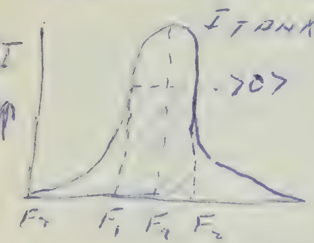
AT RESONANCE THE Z OF THE LINE IS RESISTIVE

Q - RESONANCE CURVE AND BW RESONANCE CURVE IS THE CROSS CURVE OF MAXIMUM CURRENT AND Z



SELECTIVITY THE WIDTH DECREAS SENSITIVITY THE HIGHT. IF R INCREASES "Q" DECREASES.

BAND ~~width~~ WIDTHD IS THE TOTAL No OF CYCLES ABOVE AND BELOW RES. THAT CAN BE RECEIVED ~~re~~ BY A TUNED CKT

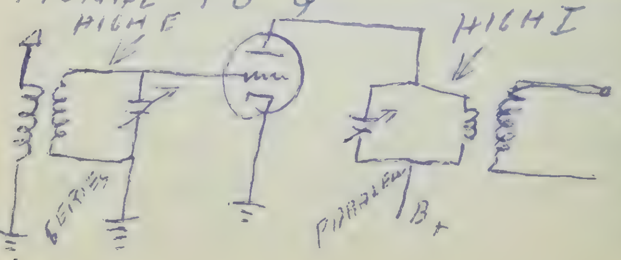


$$BW = \frac{F_r}{Q}$$

$$Q = \frac{F}{BW}$$

$$Z = \frac{X_L}{R} \; ; \; R = \frac{X_L}{Z}$$

BANDWIDTH IS DIRECTLY PROPORTIONAL TO Q



PRINCIPLES OF RADIO TRANS.

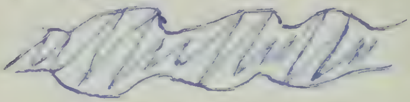
BASIC MEDIUM OF ALL COMMUNI-
CATIONS IS THE CARRIER.
TYPES: AIR - D.C. - A.C.; A
CARRIER WAVE IS A CONTINU-
WAVE (C W) - A CARRIER WAVE
IS A (C.W) AMODULATED
WAVE IS A LOW F SUPERIM
POSE IN A HIGH F (INTERRUPT-D
C.W R.F AND A.F IS THE
SAME.

RADIO TRANSMITTER
IS COMPOSE OF 6 STAGES.
OSCILATOR - BUFFER AMPLIFIER
R.F AMPLIFIER - SPEECH AMPL.
MODULATOR - POWER SUPLY
OSCILATOR GENERATES AN
R.F SIGNAL. BUFFER AMPL.
SEPARATES THE OSCILATOR
SIGNAL FROM THE ANTENA LOAD
OR FEEDBACK. R.F AMPLI ~~AM~~
AMPLIFIES THE WEAK R.F
FROM THE OSCILATOR. MIKE
CHANGES THE SOUND INTO ELEC-
TRICAL ENERGY. SPEECH AMPL.
AMPLIFIES THE SPEECH. MODU-
LATOR TO ~~CHANGE~~ VARY THE
R.F. TO A.F RATE. POWER SUPLY
SUPLYS POWER TO ALL STAGES

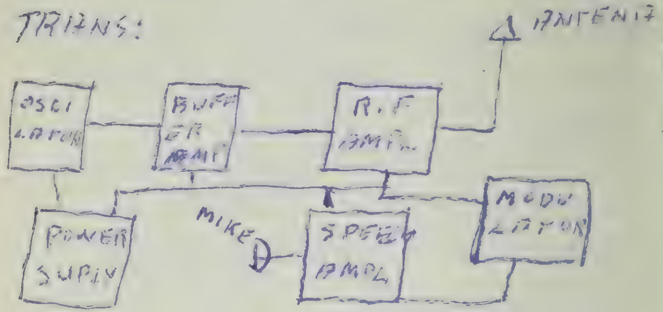
TRANSMITING ANTENA CHANGES. R.F. TO RADIO WAVE.

R.F  SAME AMPLIT

R.F MODULATED OR A.F SUPERIMPOSED



TRANS:

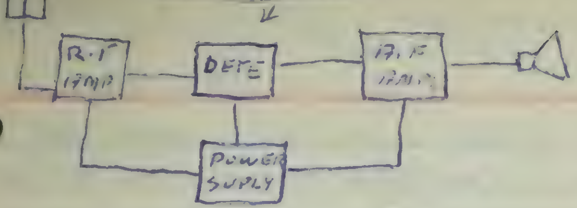


RADIO RECIVERS - (TUNED R.F) AND (SUPERHETERODYNE)

TUNED R.F: RECIVING ANTENA
R.F AMPLI. - DETECTOR - A.F AMPL
POWER SUPLY

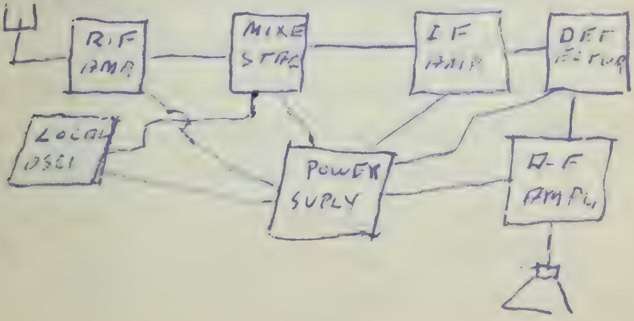
ANTENA ANTERCEPTS R.F. SIGNAL
DETECTOR - SEPARATES A.F FROM R.F. GETS RID OF R.F. - A.F AMPLIFIES WEAK A.F COMING FROM THE DETECTOR - POWER SUPLY. SUPLYS POWER TO ALL STAGES. A.C OR D.C.

TUNED R.F



SUPERHETERODYNE

R.F AMPL. - MIXER STAGE OR FIRST DETECTOR - LOCAL OSCILATOR - INTERMIDIANT F. AMP OR SECOND DETECTOR - A.F AMPLI POWER SUPLY. R.F. AMP AMPLIFIE THE INCOMING R.F - MIXER MIXES THE R.F AND OSCILATER F. AND COMES OUT WITH I.F. LOCAL OSCILATOR GENERATES A DISERED F. - I F AMPL AMPLIFIES THE I.F. SECOND DETECTOR, SEPARATES THE A.F FROM I.F. - GETS RID OF I.F. - A F AMPL AMPLI THE A.F. - POWER SUPLY



WAVE LENGTH AND F.

THE VELOCITY OF F. IS CONSTAN 300,000,000 METER/S

ONE WAVE LENGTH IS THE DISTANCE IN SPACE BETWEEN A POINT ON ONE WAVE AND THE SAME POINT OF THE NEXT WAVE. SYMBOL (λ) UNIT METER

$$\lambda = \frac{VEL}{F} \qquad F = \frac{VEL}{\lambda}$$

AUDIO F. IS THE ONES THAT THE EAR ~~———~~ NORMALY RESPONDS

A.F = 20 – 20,000 CY.

CONVERSATION 200 TO 2500 CY.

2000 IS THE A.F TO WHICH THE EAR BEST RESPONDS

R.F. 20,000 CY TO 300,000 Mc.

8 BANDS

1 – VERY LOW F. 20 – 30 Kc.
2 – LOW F. 30 – 300 Kc. SHIP TO SHORE
3 – MEDIUM F. 300 – 3000 Kc. BROADCAS
4 – HIGH F. 3 Mc – 30 Mc
5 – VERY HIGH F – 30 Mc – 300 Mc
6 – ULTRA HIGH F. 300 Mc – 3000 Mc
7 – SUPER HIGH F 3000 F – 30000 Mc
8 – XTREMELY HIGH F 30000 Mc – 300000 Mc

<u>RADIO</u> <u>COMPONENTS</u>

<u>RESISTORS</u> TO LIMIT I OR DROP E. –(BUGS) SHORTED OR OPEN DUE OVERHEATING OR

BURNED. (DO) DISCONNECT RES. AT ONE END AND TEST WITH OHMMETER.

INDUCTOR ~~ARE~~ USED AS FILTERS TO BLOCK OUT F. - SMOOTH OUT THE RIPLE OF CURRENT - SHORTED OR OPEN DUE TO CORROSION AND EXCISIVE CURRENT

CAPACITORS (BY-PASS TUNED CAP) FIX OR VARIABLE - ADJUSTABLE (COUPLING BETWEEN TO STAGES)

ELECTROLYTIC OPEN CAP. CAUSES HUM - SHORTED IT ALLOWS I TO PASS. TRANSFORMER - POWER - (A.F) (R.F) (I-F) POW - 60 CY. IRON CORE - (A.F) TO COUPLE AUDIO AND POWER STAGES IRON CORE - TREAT I.F NEARLY SAME.

R-F XMER. - RF AMPLIFIERS ZIR CARRY ONLY ONE F.

I-F XMER A SPECIAL TYPE OF R-F XMER → VACUUM TUBES

DIODE PASS I ONE DIRECTION ONLY - A TWO ELEMENT TUBE USE IN RECTIFIER AND POWER SUPLY.

TRIODES - TETRODE - PENTODE ALWAYS CHECK TUBES FIRST 90% OF TROUBLE

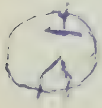
VACUUM TUBES

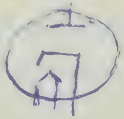
4 TYPES OF ELECTRON EMISSION

THERMIONIC EMISSION (HEAT)
SECONDARY EMISSION CAUSED BY ELECTRON BOMBARDMENT OF THE PLATE.
PHOTOELECTRIC EMISSION (LIGHT)
IONIZATION CAUSED BY GAS ELECTRON BOMBARDMENT
GREATER EMISSION - LARGER AREA OF EMITTER. MORE HEAT
~~THERM~~: TYPES OF EMITTERS. DIRECTLY OR INDIRECTLY HEATED. FILAMENTS TUNGSTEN IN DIRECTLY HEATED ARE COATED WITH EMITTER (OXIDE) THORIATED COATED - OXIDE MORE EFFICIENT REQUIRES LESS HEAT. RED COLOR.

DIRECTLY HEATED CATHODE

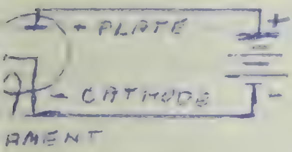
INDIRECTLY HEATED CATHODE. FILAMENT IS THE HEATER





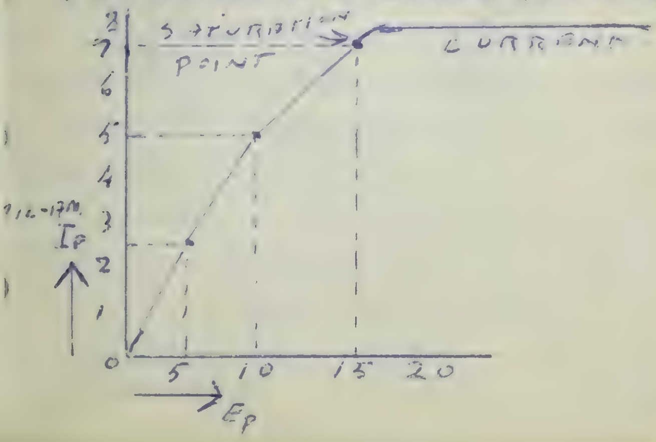
DIODES - TWO ELEMENT TUBE CATHODE AND PLATE (ANODE) CATHODE IS POSITIVE. PLATE ALLWAYS NEGATIVE - ELECTRONS FLOW FROM CATHODE TO PLATE

CALLED PLATE CURRENT
I_p) - PLATE VOLTAGE IS THE
POTENTIAL DIFFERENCE BETWEEN
CATHODE AND PLATE. <u>GETTER</u>
S MAGNESIUM OR BARIUM THAT'S
BURNED INSIDE THE TUBE TO ELI-
MINATE ALL GASES AND GET
COMPLETE VACUUM. SPACE CHARGE
S A CLOUD OF ELECTRONS THAT
DON'T REACH THE PLATE AFTER
BEING EMITTED BY THE CATHODE.
E. POINT OF <u>SATURATION</u>
IS THE POINT OF MAXIMUM
ELECTRON FLOW IN TUBE
SIMPLE DIODE CKT



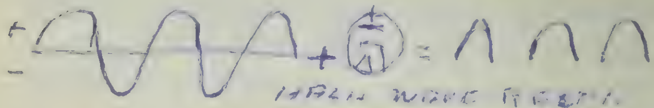
DIODE USED AS RECTIFIER AND DETECTOR

SATURATION CURVE (PLATE)



DIODE RECT ARE USED TO CONVERT A.C TO P.D.C TO RECEIVE FOR THE USED OF OTHER TUBES

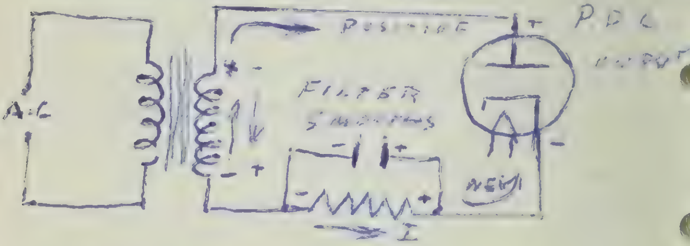
HALF WAVE RECTI. A.C. INPUT VOLTAGE - CURRENT IN TUBE FLOW ONE WAY ONLY - P.D.C. OUTPUT



HALF WAVE RECTI.

IN NEGATIVE SIDE OF CYCLE NO CURRENT DUE TO NO ELECTRON FLOW. E_p INCREASE I_p INCR. MORE ELECTRON ATTRACTION BY PLATE. PEAK INVERSE VOLTAGE IS THE MAXIMUM NEGATIVE VOLTAGE THAT CAN BE APPLIED TO THE PLATE WITHOUT ARCING OVER. ON THE NEGATIVE SIDE OF THE CYCLE

HALF WAVE DIODE RECT

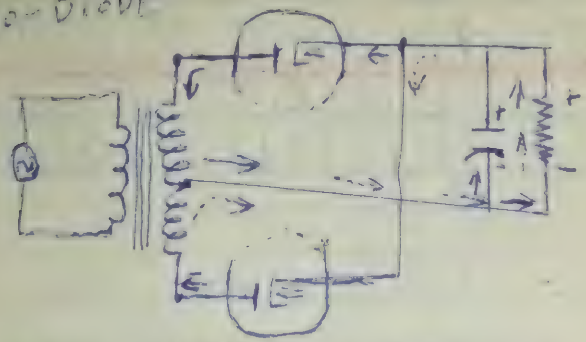


DUO DIODE OR FULL WAVE RECTIFIER, A DIODE WITH TWO PLATES.

DUO DIODE

FULL WAVE RECTIFIER

DUO-DIODE



AMPLIFING TUBE

THE TRIODE

CONTROL GRID CONTROLS THE CURRENT FLOW IN TUBE - CLOSE WINDINGS HIGHER AMPLIFICATION WIDE LOW AMPLIFICATION. GRID NEGATIVE, LOW CURRENT IN PLATE. GRID POSITIVE, HIGH I.
A.C. SIGNAL APLIED TO GRID A.C. VOLTAGE TO CONTROL

BIAS - BIAS IS AN STEADY DC VOLTAGE THAT EXISTS BETWEN GRID AND CATHODE. TOTAL GRID E (EG) A.C. + D.C.

CUT OFF POINT IS WHEN THE NEGATIVE GRID VOLTAGE IS ENOUGH TO CUT OFF THE CURRENT FLOW IN THE TUBE

SYMBOLS: EBB - PLATE VOLTAGE I_P (I_B) PLATE CURRENT - E_C (E_G) GRID VOLTAGE - I_G (I_C) GRID

CUT OFF POINT

EG – NEGATIVE POSITI

E_G	-12	-11	-9	7.5	6	4.5	3	1.5	0	+1.5
I_P	0	0	0	1	3	6	9.5	13	17	21
I_G	0	0	0	0	0	0	0	0	9	.5

CUT OFF POINT

CURRENT VARIATIONS

SIGNAL	0	+1.5	-1.5	0
EG	-3	-1.5	-4.5	-3
IP	9.2	13	5.8	9.2
EP	175	175	175	175

PLATE LOAD TO MAKE USE OF IP VARIATIONS AND HAV A VOLTAGE DROP IN THE OUTP CKT.

	SIG	0	+1.5	-1.5	0
	EG	-3	-1.5	-4.5	-3
	IP	8	10.5	5	8
	EP	167	164	170	167
LOAD →	ERL.	8	10.5	5	8

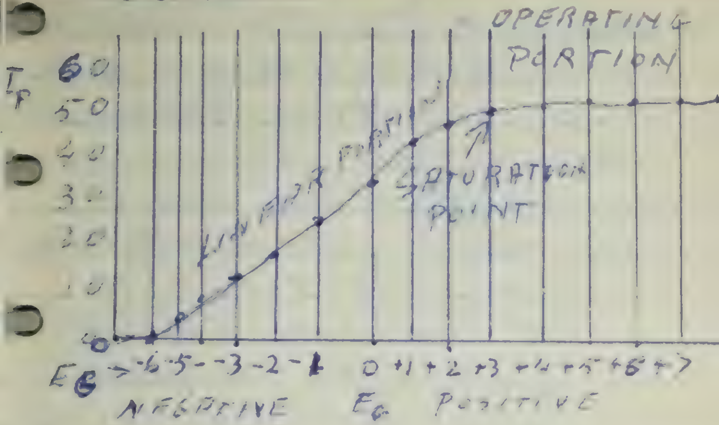
THE PLATE LOAD VOLTAGE IS 180° OUT OF PHASE WITH THE A.C. SIGNAL

GRAPHS AND CURVES – A PICTO RIAL REPRESENTATION ~~of~~ BET THE CHANGING VALUES AND THE RELATIONSHIP.

PLATE CURVES - TWO KINDS

STATIC CURVE - NO PLATE LOAD

DYNAMIC CURVE - WITH LOAD



TUBE CONSTANTS

A.C. PLATE RESISTANCE (R_P)

TRANSCONDUCTANCE (~~T_C~~) (G_M)

AMPLIFICATION FACTOR (M_U)

R_P IS THE RESISTANCE BETWEEN THE CATHODE AND PLATE OR RATIO OF CHANGE IN E_P AND I_P WITH E_G CONSTANT.

$$R_P = \frac{\Delta E_P}{\Delta I_P} \quad E_G \text{ CONSTANT (OHMS)}$$

(G_M) MUTUAL CONDUCTANCE IS THE ABILITY OF THE GRID VOLTAGE TO CONTROL THE I_P OR THE RATIO OF CHANGE BETWEEN I_P AND E_G - WITH E_P CONSTANT

$$G_M = \frac{\Delta I_P}{\Delta E_G} \quad E_P \text{ CONSTANT (MHO) } \mu\text{MHO}$$

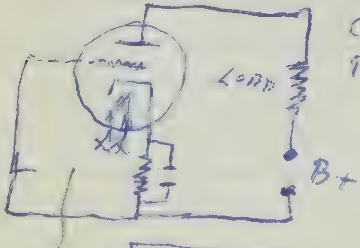
MU - IS THE RATIO OF CHANGE IN E_p AND E_g TO PRODUCE THE SAME CHANGE IN I_p

$$Mu = \frac{\Delta E_p}{\Delta E_g}$$ AMPLIFICATION FACTOR OR TUBE RATIO

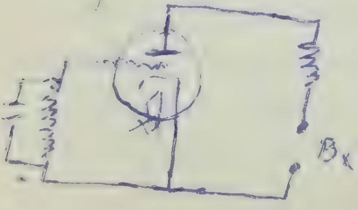
BIAS - TWO TYPES

FIXED BIAS AND SELF BIAS

FIXED BIAS IS SUPPLY BY OUTSIDE VOLTAGE (C) BATTERY. SELF BIAS TWO KINDS. BIAS PRODUCED BY CKT ITSELF. CATHODE ~~[illegible]~~ RESISTOR - GRID LEAK. CATHODE RESISTOR BIAS PRODUCED BY I_p - VARIES SO USE CAPACITOR. GRID LEAK PRODUCED BY I_g.

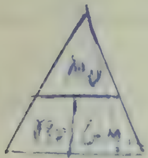


CATHODE RESISTOR BIAS



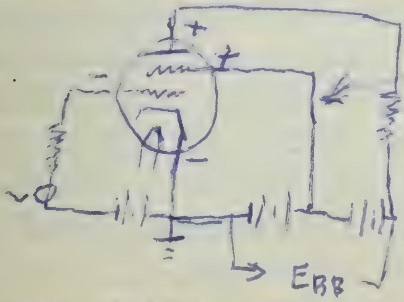
GRID LEAK BIAS

DISADVANTAGES OF TRIODE
VERY LOW AMPLIFICATION FACTOR 4 TO 25.
CAPACITANCE BETWEEN GRID AND PLATE - INTERELECTRODE CAPACITANCE. COUSING FEED BACK AND DISTORTION RELIVED BY NEUTRALIZING CKT.



TETRODES

TO CUT OFF INTERELECTRODE CAPACITANCE THE SCREEN GRID AT HIGH FREQUENCIES. SCREEN GRID VOLTAGE IS POSITIVE AND IT HELPS THE PLATE TO ~~ATT~~ ATTRACT ELECTRONS. SCREEN VOLTAGE LESS THAN EP.



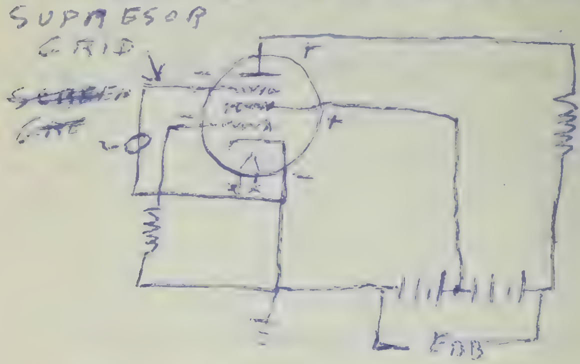
SCREEN GRID

HIGH AMPLIFICATION FACTOR

WITH HIGH SPEED ELECTRONS HITTING THE PLATE PRODUCES SECONDARY EMISSION

PENTODES

TO ELIMINATE SECONDARY EMISSION THE SUPRESOR GRID IS PUT ON AND IT IS MADE NEGATIVE TO SEND THE ELECTRONES BACK TO THE PLATE



THE BEAM POWER TUBE IS USED FOR POWER SUPLY BECAUSE HIGH POWER ABILITY. IT USES REFLECTOR PLATES

VARIABLE MU TUBES ARE USED TO CONTROL THE INPUT SIGNAL BY CONTROLING THE GRID - USED WHE HIGH BIAS IS NEEDED - CONTROL GRID WIDING ARE CLOSER AT THE ENDS AND SEPARATE AT THE CENTER.

POWER SUPPLIES

NEED OF POWER SUPPLIES

1. TRANSMITTERS (a) - HIGH VOLTAGES TO THE PLATE. (b) HIGH CURRENTS. (c) AC OR DC.
2. RECEIVERS (a) LOW VOLTAGES (b) LOW CURRENTS. (c) AC. OR DC.

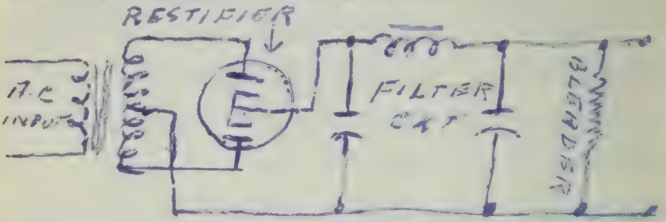
FILAMENT VOLTAGE - LOW "A" AC OR DC - PLATE (B+) HIGH VOLTAGE - SCREEN (B+) VOLTAGE GRID BIAS (C) NEGATIVE DC HIGH OR LOW.

KINDS OF P.S. BATTERY - AC POWER SUPPLY - TRANSFORMER RECTIFIER - ELECTROMECHANICAL SYSTEMS.

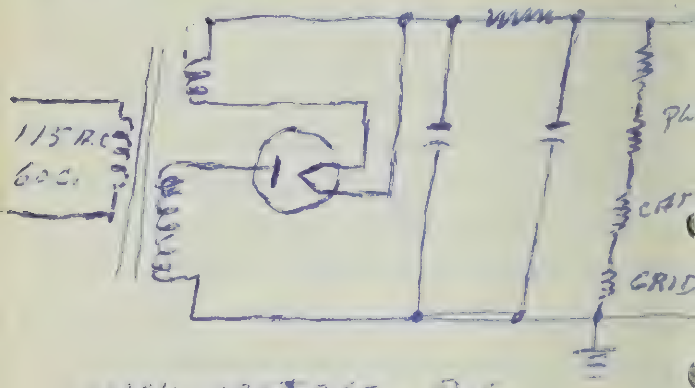
BATTERIES SUPPLY PURE D.C TEST METERS - BULKY - REPLACEMENT - VOLTAGE AND CURRENT LIMITED. P.S COMPONENTS AC - POWER TRANSFORMER - RECTIFIER - FILTER CKT - BLEEDER RESISTOR - VOLTAGE DIVIDER

TRANSFORMER TO INCREASE OR DECREASE A.C. INPUT - RECTIFIER TO RECTIFY AC TO P.D.C. FILTER CKT TO SMOOTH OUT THE P.D.C TO ALMOST PURE D.C. BLEEDER - HIGH RESISTANCE ACROSS P.S TO DISCHARGE THE FILTER

WHEN THE P.S. IS TURNED OFF AND USED AS A VOLTAGE DIVIDER TO TAP OFF VARIOUS VOLTAGES. ACTS AS A LIGHT LOAD FOR THE P.S WHEN IS TURNED ON. VOLTAGE REGULATE TO KEEP THE OUTPUT AT A CONSTANT VALUE.



LOW VOLTAGE POWER SUPPLY



HIGH VOLTAGE P.S.

RECTIFIERS

VACUUM TUBES AND METALIC

~~LOW~~ HALF WAVE AND FULL WAVE

HALF LOW EFFICIENCY NEED LARGE FILTERING. FULL GOOD LESS FILTERING

VACUUM TUBES. AND METALLIC
RECTIFIERS.

VACUUM TUBES - RUGGED STAND
AGAINST JUMPS OF CURRENT
HIGH VACUUM TUBES NOT VERY
EFFICIENT - USED LOW POWER
TRANSMITTER AND RECEIVER
HIGH INTERNAL VOLTAGE DROP
HIGH MAXIMUM INVERSE PEAK
VOLTAGE. GASEOUS TUBES. MER
CURY VAPOR DIODE WITH MER
CURY VAPOR - WILL NOT STAND
SURGES OF CURRENT - LOW INVER
SE PEAK VOLTAGE DUE TO IONIZA
TION - REDUCE SPACE CHARGE.
ELECTRON BOMBARD THE GAS
ATOMS AND PRODUCE MORE ELEC
TRONS RESULT LARGE I_p - LOW
VOLTAGE DROP 10-15 VOLTS
USED IN HIGH VOLTAGE CKTS.
TO DELIVER LARGE AMOUNT OF I
METALLIC RECTIFIERS TWO DISSI
MILAR SURFACES HAVING
PROPERTY OF PASSING CURRENT
ONE WAY ONLY. SELENIUM - COP-
PER OXIDE. ELECTRODE COATED
WITH COPPER OXIDE IN ONE SIDE.
SELENIUM - IRON OR ALUMINUM
DISK SELENIUM COATE IN ONE SI-
DE - SELENIUM POOR CONDUCTOR

SELENIUM RECTIFIER DISK
COMPONENTS; FRONT ELECTRODE - BARRIER LAYER - SELENIUM OR POOR CONDUCTOR - BACK ELECTRODE -

FRONT ELECT

BACK ELECT

BARRIER LAYER

POOR CONDUCTOR

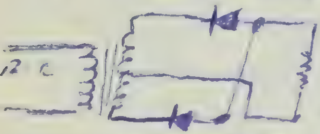
FRONT ELECTRODE
GOOD CONDUCTOR

BARRIER LAYER - NO FREE ELECTRONS

BACK ELECTRODE
GOOD CONDUCTOR

CURRENT FLOWS EASE ONE WAY - VERY LITTLE OTHER WAY. - LOW PEAK VOLTAGE - LOW BREAKDOWN VOLTAGE LOW MELTING POINT - NO GOOD AT HIGH TEMPERATURE - ADD DISK IN SERIES FOR MORE VOLTAGE (BREAK DOWN) - PARALLEL MORE I → I DIRECTION

SYMBOL 



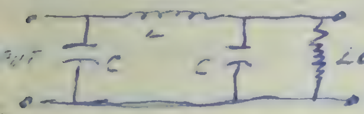
FULL WAVE SELENIUM RECTIFIER

FILTER CKTS

LOW PASS HIGH PASS. BAND PASS - BAND REJECT - PARTS - CAPACITORS - INDUCTORS (CHOKES) RESISTORS - LOW PASS. PASSES LOW F. A.C D.C. REJECTS HIGH F.
PI-TYPE - HIGH PASSES HIGH F.

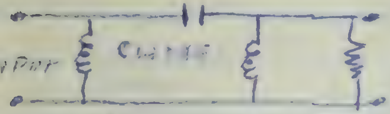
~~FILTER~~ REJECTS LOW F AND D.C.
BAND PASS PASSES ONE BAND
R.F. REJECTS ALL OTHERS ABOVE
OR BELOW RESONANCE - REJECT
BAND REJECTS ONE BAND AND
PASSES ALL OTHERS

CAPACITOR FILT. PI-TYPE



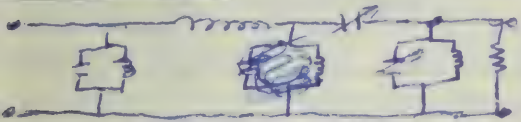
LOW PASS
HIGH OUTPUT
VOLTAGE

~~STEP~~ INDUCTOR FILT PI TYPE



HIGH PASS
LOW VOLTAGE
GOOD REGULA-
TION

BAND PASS

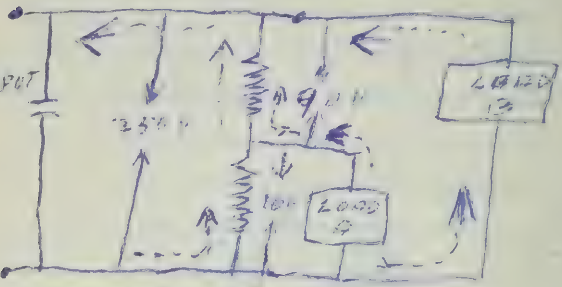


BAND REJECT

SERIES OR PARALLEL TUNED CKT
CHOKE INPUT FILTERS IN PS
VERY GOOD VOLTAGE REGULA-
TION. LOW PASS IN PS WILL
SMOOTH OUT POWER VARIATIONS
INPUT

BLEEDERS AND VOLTAGE DIVIDER

RESISTOR OR SERIES RESISTOR ACROSS OUTPUT OF P.S. AND TAPPED AT VARIOUS POINTS.
ACTS AS A BLEEDER FOR SAFETY ALSO AS A FIX LOAD FOR P.S.
THIS LOAD IS ABOUT 10 OR 15 PERCENT OF TOTAL CURRENT
POWER RATING OF RESIS. VERY IMPORTANT, WHETHER OR WHAT THE RESISTOR WILL BURN UP



VOLTAGE DIVIDER

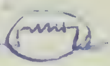
THE VOLTAGE DIVIDER CAN BE USE FB TO GET NEGATIVE VOLTAGES WITH RESPECT TO GROUND (B−) WHEN A POINT OTHER THAN ~~GROUND~~ B− IS USED AS GROUND
USING OHMS LAW WE CAN FIND ALL THE VALUES IN THE VOLTAGE DIVIDER REMEMBERING THE DIRECTION FLOW OF I. FROM − TO +

VOLTAGE REGULATOR

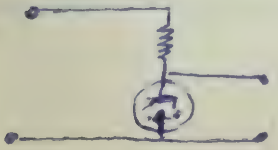
OUTPUT VOLTAGES CHANGES
LOAD CHANGES.

V.R. IS AN ELECTRONIC DEVICE ACROSS THE OUTPUT OF THE PS TO MAINTAINE A CONSTANT OUTPUT VOLTAGE - AMPERITE AND GLOW TUBE - V-R.

AMPERITE THIS DEVICE IS A ~~[illegible]~~ IRON WIRE RESISTANCE SEALED IN A ELECTRONIC TUBE WICH CONTAINS HELIUM OR HYDROGEN GASS FOR RAPID COOLING HIGH POSSITIVE TEMPERATURE COEFFICIENT - CAUSES LARGE VARIATIONS OF RESISTANCE WITH SMALL CHANGES OF CURRENT.

~~[illegible]~~ SYMBOL 

GLOW TUBE TWO ELEMENT COLD CATHODE FILLED WITH NEON OR ARGON - IS A FIX VOLTAGE REGULATOR - IT REGULATES BY ~~[illegible]~~ VARYING THE IONIZATION AND IMPEDANCE - IT MUST HAVE A RESISTOR. DESIGNATION - VR.150-30



SYMBOL

VIBRATOR POWER SUPPLY
SYNCRONOUS AND NON-SYNCRONOUS

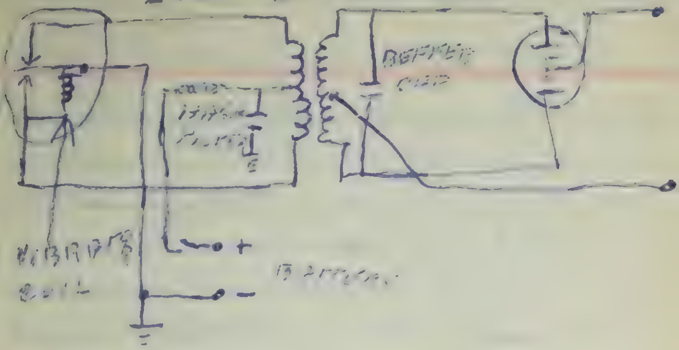
VIBRATOR CHANGES LOW D.C. TO HIGH D.C. IS A MECHANICAL DEVICE LIKE A SWITCH WHICH OPENS AND CLOSES THE CONTACTS AT HIGH SPEED DUE TO AN ELECTROMAGNET - IS IT IN A TUBE CONNECTED TO THE PRIMARY OF THE TRANSFORMER

SYNCRONOUS IS A SELF RECTIFYING - NON SYNCRONOUS NEEDS SEPARATE RECTIFIER

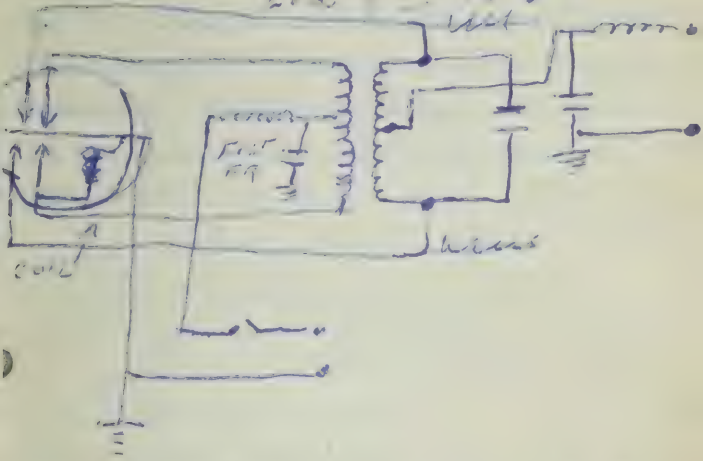
A HASH FILTER IS CONNECTED IN THE PRIMARY TO STOP R.F. FROM THE VIBRATOR. A BUFFER CAPACITOR ACROSS THE SECONDARY TO ABSORB VOLTAGES CHANGES - FREQUENCY RANGES FROM 115 TO 220 CYCLES DS. VIBRATOR MORE EFFICIENT THAN DYNAMOTOR COMPACT LIGHT - LIMITED CURRENT WEAR OF POINTS OF CONTACT. SYNCRONOUS ONE MORE SET OF CONTACT

WAVE FORM

NON SYNCRONOUS
LOW D.C TO HIGH D.C



SYNCRONOUS
LOW D.C. TO D.C



VIBRATORS MAINLY USED IN MOBILE EQUIPMENT

DYNAMOTORS

ELECTROMECHANIC DEVICE TO CHANGE LOW DC TO HIGH D.C. MOTOR AND GENERATOR - BOTH WINDINGS IN SAME ARMATURE MADE OF LAMI

SPEED FOR LESS SERVICE.
TO INCREASE OR DECREASE

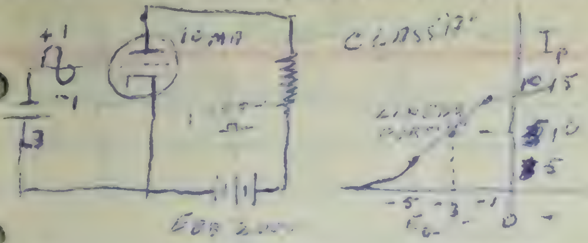
OUTPUT - INCREASE OR DECREASE GENERATOR WINDINGS.
IT HAS A PI-FILTER INPUT
IN THE MOTOR TO ELIMINATE
R.F FROM BRUSHES AND
PI-FILTER IN OUTPUT FOR SAME
REASONS. BIG CAPACITORS
AND BIG CHOKES INPUT.
CONSTANT SPEED: SHUNT
WOUND - LESS THAN 50%
EFFICIENT - MAINTENANCE -
CHECK FUZE - DIRTY COMMUTA-
TOR - HIGH MICA. ARCS OVER
LARGE SEGMENTS IN COMMU-
TATOR ARE MOTORS

AMPLIFIERS - A.F + R.F

PURPOSE IS TO INCREASE THE
STRENGTH OF A SIGNAL.
A.F. 20 TO 20,000 CPS. MOST IMPOR-
TANT 10,000 CPS - T.V SWEEP OSC.
17,500 CPS. - R.F. 20 KC AND HI-
GHER. I.F. 160 KC. TO 480 KC
AROUND 455 KC. IN BROADCAST
SUPERHETRODYNE. I.F. IS THE
DIFFERENCE BETWEEN THE
R.F AND THE SIGNAL PUT OUT
BY THE OSCILATOR.

AUDIO AMPLIFIERS VOLTAGE

PROCESS OF AMPLIFICATION

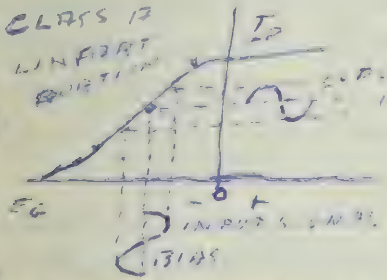


$R = 10.000 \times .010 = 100\,V\ E_L$

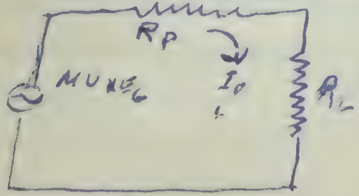
$E_p = 200 - 100 = 100\,V\ E_p$

SIGNAL FROM ~~-1 TO~~ -4 TO -2

PLATE VOLTAGE - IF GRID MORE NEGATIVE - I_p DECREASES. E_p INCREASES E_L DECREASES. GRID LESS NEGATIVE. I_p INCREASES - E_p DECREASES E_L INCREASES CLASS "A"

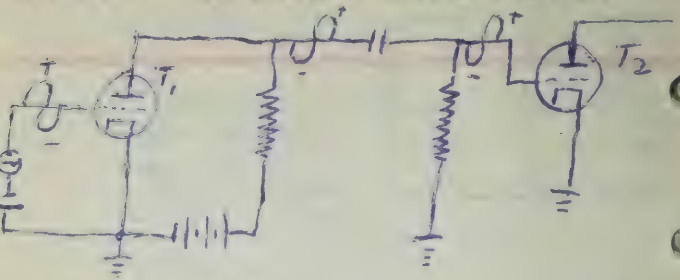


EQUIVALENT CKT OF AMP NOT ACTUALLY CKT



$$I_p = \frac{MU \times E_G}{R_p + R_L}$$

PHASE RELATIONSHIP BETWEEN OUTPUT SIGNAL AND INPUT



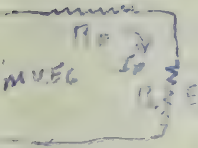
OUTPUT OF TUBE, APPLIED TO T_2 IS 180° OUT OF PHASE WITH INPUT SIGNAL

CLASS "A" USED IN MICROPH. AND RECORD PLAYER. CLASS "A" OPERATES IN THE CENTER OF THE LINEAR PORTION OF THE E_g-I_p CURVE. - CURRENT IN PLATE FLOWS ALL THE TIME. 360° FULL CYCLE. FIDELITY IS THE DEGREE OF ACCURACY TO WHICH AN AMP. WILL REPRODUCE THE INPUT SIGNAL IN THE OUTPUT. CLASS "A" EXCEL. FIDELITY. SENSITIVITY IS THE ABILITY OF AN AMP. TO RE PRODUCE SATISFACTORY WEAK SIGNALS. CLASS "A" GOOD SENSITIVITY. NONLINEAR DISTORTION. DISTORTED OUTPUT SIGNAL DUE TO EXCESSIVE BIAS - INSUFFICIENT BIAS - EXCESSIVE SIGNAL APPLIED.

VOLTAGE AMPLIFICATION

A [illegible] AMPL. IS USED AS A VOLTAGE AMPL. TO PRODUCE VOLTAGE VARIATIONS (CAUSED BY THE VARIATING I_p AND E_G) ACROSS THE LOAD RESISTOR R_L. THE RATIO OF THIS VARIATION — A.C. OUTPUT VOLTAGE TO A.C. INPUT SIGNAL IS THE VOLTAGE AMPL OR GAIN. GAIN FACTORS MU OF THE TUBE. PLATE IMPEDANCE (R_p) - LOAD RESISTANCE (R_L)

$$VA = \frac{E_L}{E_G}$$



$$E_L = I_p \times R_L$$

$$I_p = \frac{Mu \times E_G}{R_L + R_p} \qquad E_L = \frac{Mu \times E_G}{R_p + R_L} (\times R_L)$$

$$VA = \frac{\frac{Mu \times \cancel{E_G}}{R_L + R_p} \times R_L}{\cancel{E_G}} \qquad \boxed{VA = \frac{Mu \times R_L}{R_L + R_p}}$$

MAXIMUM VOLTAGE AMPLIFICATION USES A PLATE LOAD RESISTANCE OF 3 TO 10 TIMES THE TUBE PLATE RESISTANCE

$$R_L = 3 \text{ TO } 10 \times R_p$$

MU	RP	RL	VA
20	10000	10000	10
20	10000	[illegible]	[illegible]

TRIODE HAS A "MU" OF AROUND 100# EXCELENT FIDELITY.

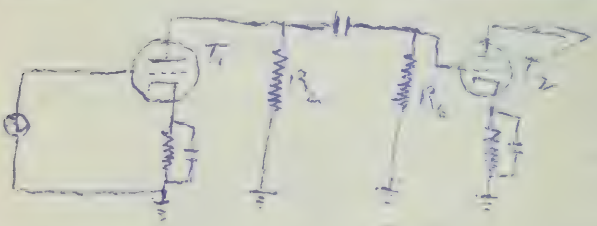
PENTODE HAS A "MU" OF 1000 INCREASE DISTORTION

TYPES OF COUPLING

FREQUENCY RESPONSE - VOICE BASS LOW FREQUENCY 80 TO 350 CPS SOPRANO 250 - 1150 CPS - INSTRUMENTS - PICOLO - 512 - 4600 CPS PIANO 40 - 8000 CPS HARMONICS UP TO 10,000 C.P.S.

TYPES OF

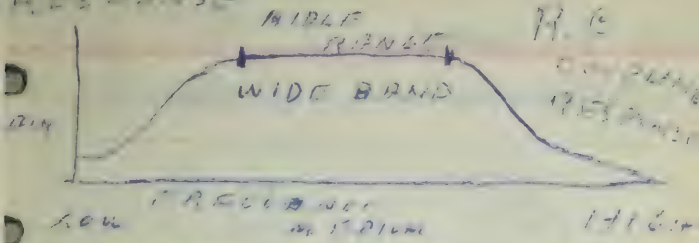
COUPLING IS A DEVICE USED TO PASS THE SIGNAL FROM ONE STAGE TO THE OTHER. KINDS OF COUPLING RESISTANCE - CAPACITANCE (R.C) IMPEDANCE COUPLING - TRANSFORMED COUPLING. R.C COUPLING



RL - ACTS AS A LOAD FOR T_1

RG - GRID RETURN RESISTOR - PREVENT FLOATING GRID. CONECTS GRID TO CATHODE. RL 10 TIMES AS GREAT AS RP - RG VERY LARGE

R.C. COUPLING - GOOD FREQUENCY RESPONSE



R.C. COUPLING GIVES HIGH B+ HIGH FIDELITY OVER WIDE RANGE OF. AT LOW FREQ. HIGH REACTANCES. AT HIGH FREQUENCIES LOW INTERELECTRODE CAPACITANCE. VALUES OF R AND C CONTROL THE FREQUENCY RESPONSE

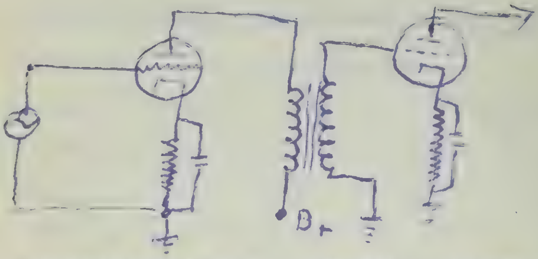
IMPEDANCE COUPLING - IS ALMOST THE SAME CKT THAN R.C. A LARGE INDUCTOR WITH IRON CORE (CHOKE) IS PUT IN PLACE OF THE LOAD RESISTOR. GREATER AMPLIFICATION GAIN. POOR FRE. RESPONSE. NARROW BAND.

SELDOM USED

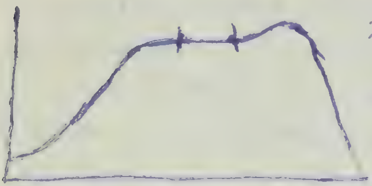
FREQUENCY RESPONSE IS THE RESPONSE OF AN AMPL. ITS GAIN ~~OVER~~ AT A PARTICULAR F. OR THE

MANNER IN WHICH THE GAIN VARIES OVER A WIDE RANGE OF FREQ. ~~TEMP~~

TRANSFORMER COUPLING.

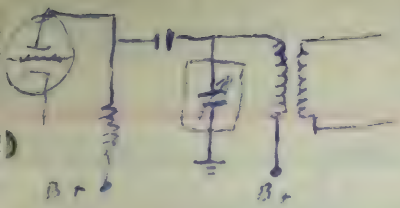


PRIMARY OF TRANS. ACTS AS LOAD FOR PLATE. CAN BE USED FOR IMPEDANCE MATCHING. LEVEL OF F. RANGE LIMITED

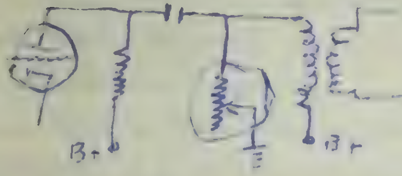


TRANSFORMER COUPLING LIMITED RANGE

TONE CONTROL - THE FREQ. RESPONSE RANGE DEPENDS ON TRANS. TONE CONTROL TO COMPENSATE FOR "F. RESPONSE IN LOW F. HIGH F. TONE CONTROL TO GROUND OUT HIGH F. COMPONENTS REDUCING RESPONSE F. BY CHANGING VALUES OF RESISTANCE OR CAPACITANCE.

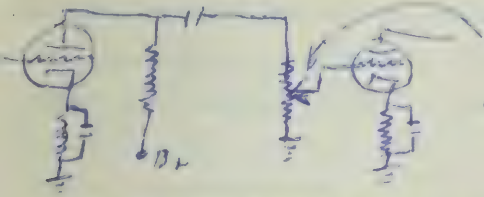


VARIABLE CONDENSER TONE CONTROL



VARIABLE RESISTOR TONE CONTROL

<u>VOLUME CONTROL</u> CONTROLING THE OUTPUT OF THE TUBE BY CONTROLING THE GRID VOLTAGE



GRID CONTROL VOLUME.

<u>BIAS</u> - SOURCES AND NEGATIVE

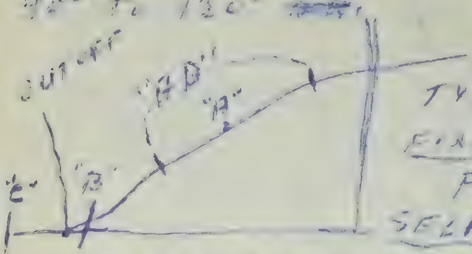
(1) CONTROL PLATE CURRENT DETERMINE THE AMPLIFIER OPERATING POINT. <u>IN CLASS "A"</u> BIAS IN CENTER OF ~~the~~ LINEART PORTION OF CURVE. I_p FLOWS 360°. <u>IN CLASS "B"</u> NEAR CUTT OFF POINT. I_p FLOWS 180°.

<u>CLASS AB₁</u> ANY WHERE BETWEN "A" AND "B" CURRENT FLOW "AB"

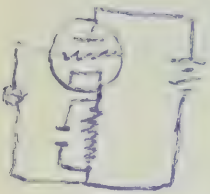
<u>CLASS AB₂</u> SAME AS "AB₁" EXCEP CURRENT FLOWS IN GRID

LARGE SIGNAL GOES TO POSITI-
VE GRID VALUE. CLASS "C"

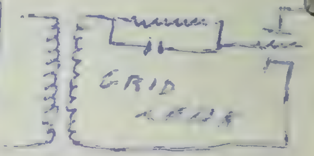
TWICE CUTOFF POINT. IS FROM
90° TO 120°



TYPES BIAS
FIXED - BATTERY
POWER SUPPLY
SELF BIAS
GRID LEAK - CATHODE RESISTOR



CATHODE
RESISTOR
BIAS

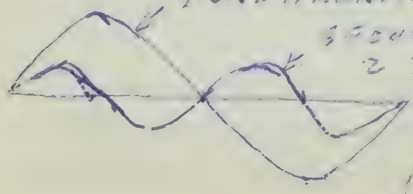


CHARACTERISTICS OF SOUND

FREQUENCY = PITCH - 20 TO 20,000 C.P.S

PURE TONE IS A SINE WAVE

HARMONIC ARE OVERTONES. MULTI-
PLE OF THE FUNDAMENTAL FREQ.
HARMONICS ARE SMALL IN AMPLI-
TUD. HARMONICS PRODUCE THE
QUALITY OF TIMBRE. LOUDNESS-
INTENSITY.

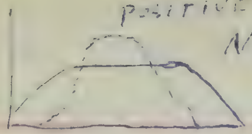


DISTORTION IN R.F. AMP.

CAUSED WHEN THE OUTPUT SIG-
NAL IS NOT EXACT REPRODU-
CTION OF THE INPUT SIGNAL

1) FREQUENCY DISTORTION ~~CAU~~
CAUSED BY THE CKT NOT PASSING
ALL FR. THE SAME - GAIN FALLS
OFF. R.C. COUPLED AMP. HAS
2) DISTORTION: NON LINEAR DIS-
TORTION - CAUSED BY IMPROPER
BIAS - TOO STRONG SIGNAL -
OVER DRIVING THE STAGE = AMPLI-
TUDE DISTORTION. PHASE DISTORTION
IN R.F. PHASE DIFFERENCE OF SIGNAL
IS TOLERATED BECAUSE THE
EAR IS NOT CRITICAL [illegible].

FEED-BACK & FILTERS. FEED-
BACK IS WHEN A PORTION OF THE
OUTPUT VOLTAGE IS FED BACK TO
THE INPUT TERMINALS OF THE
AMP. POSITIVE = REGENERATIVE
NEGATIVE = DEGENERATIVE.
POSITIVE FEEDBACK WHEN FED
BACK INCREASES THE GAIN AT
PARTICULAR FR. NARROW BAND
PASS. IF POSITIVE FEEDBACK EXCE-
SSIVE THE AMPLIFIER WILL
OSCILLATE. IN PHASE WITH INPUT
SIGNAL AND ADDING TO IT



NARROW BAND PASS
HIGHER GAIN

NEGATIVE FEEDBACK - REDUCES GAIN. REDUCES DISTORTION. IMPROVES OUT STABILITY. WIDEN UP BAND PASS. 180° OUT PHASE WITH INPUT SIGNAL.

NEGATIVE FEEDBACK WIDENS UP BAND PASS.

DECOUPLING FILTER IS TO PREVENT UNDESIRED FEEDBACK FROM AFTER TO EARLIER STAGES, AND KEEP IT FROM OSCILLATING.

DECOUPLING FILTERS

CLASS "B" R.F. POWER AMP.

A POWER AMP. USED TO DELIVER POWER TO ITS LOAD CKT, CHANGES D.C. POWER TO A.C POWER. D.C. FROM POWER SUPPLY - A.C. APPLIED - USED ~~FOR~~ TO DRIVE SPEAKER - MODULATOR

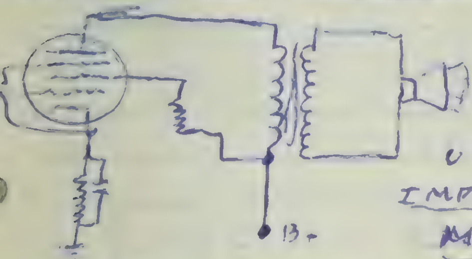
POWER SENSITIVITY OF CLASS A R.F POWER AMPL. = RATIO OF POWER OUTPUT TO SIGNAL INPUT SQUARE

POWER SENSITIVITY = $\frac{\text{POW OUTP}}{E_G^2}$

POWER TUBES TRIODE - LOW POWER SENSITIVITY - LOW EFFICIENCY.

BEAM POWER - HIGH POWER OUTPUT HIGH POWER SENSITIVITY - HIGH EFFICIENCY.

FEATURE COUPLE FOR POWER OUTPUT TO SPEAKER



TRANSFORMER COUPLING USING IMPEDANCE MACHING

FOR MAXIMUM POWER TRANSFER WE HAVE $R_L = R_P$

FOR MAXIMUM ~~UNDISTO~~ UNDISTORTED POWER R_L = TWICE LARGER THAN R_p.

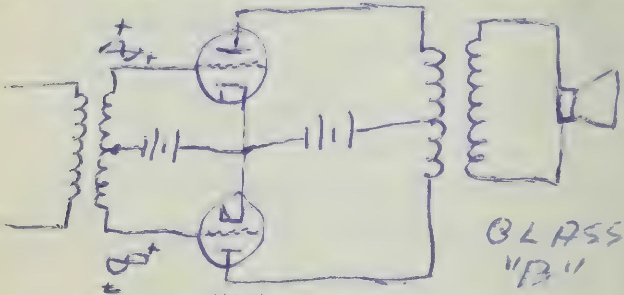
IMPEDANCE MATCHING

FOR MAXIMUM POWER TRANSFER WE MUST HAVE IMPEDANCE MATCHING IN THE

PRIMARY AND SECONDARY, AND IS FOUND BY THE TURNS RATIO.

$$\frac{Z_P}{Z_S} = \left(\frac{N_P}{N_S}\right)^2 \qquad \frac{N_P}{N_S} = \sqrt{\frac{Z_P}{Z_S}}$$

PUSH PULL AMPLIFICATION: TWO TUBES THE GRIDS EXCITED BY VOLTAGES EQUAL AND 180° OUT OF PHASE, AND WHOSE PLATE OUTPUT ARE COMBINED BY A CENTER TAPPED TRANSFORMER. PURPOSE: MORE THAN TWICE POWER OUTPUT. ALMOST NO DISTORTION BY HARMONICS (EVEN); NEARLY EVER USED IN CLASS "B". SECOND HARMONICS MAIN CAUSE OF DISTORTION IN TRIODES.



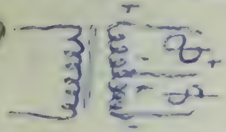
CLASS "B"

IN CLASS "B" BIAS PUSH-PULL BIAS IS ALMOST CUTOFF BEFORE SIGNAL APPLIED. CAN HANDLE LARGE SIGNAL.

HIGH EFFICIENCY - MORE OUT-PUT POWER THAN CLASS "A"

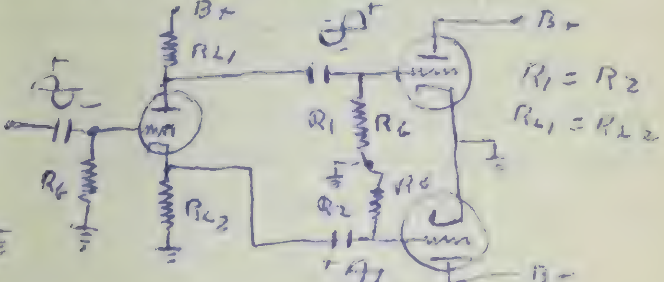
PHASE INVERSION & RF AMPLIFIERS

A PHASE INVERTER IS A DEVICE WHICH INVERTS THE POLARITY OF THE SIGNAL - TRANSFORMER OR TUBE

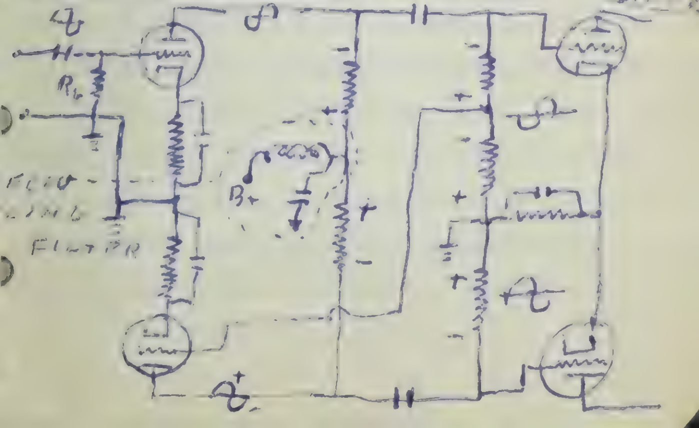


TRANSFORMER COUPLE PHASE INVERTER

SINGLE ENDED & TRANS. COUPLED TO PUSH-PULL ONE KIND OF PHASE INVERTER.

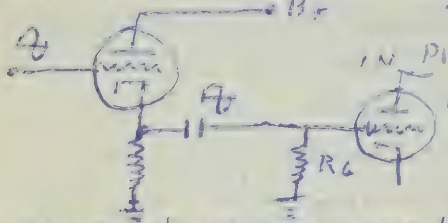


HIGH GAIN PHASE INVERTER [illegible]



DECOUPLING FILTER IS TO PREVENT FEEDBACK FROM LATTER TO FORMER STAGES

CATHODE FOLLOWER TO COUPLE A HIGH IMPEDANCE CKT SUCH AS A OUTPUT OF AMPL. TO LOW IMPEDANCE LOAD. HIGH POWER GAIN WIDE RANGE OF FLAT FR. RESPONSE, LOW DISTORTION



SINE WAVE IN PHASE WITH OUTPUT NOT AMPL.

CLASS "AB" "B" AND "C" AMPL.

CLASS "B" OPERATING NEAR CUT OFF POINT – BIAS CUTOFF – I_p FLOWS 180° – POOR SENSITIVITY – POOR FIDELITY – GOOD EFFICIENCY 50-65% USED IN R.F. AND TO COUPLE A SINGLE ENDED STAGE TO DOUBLE THROUGH PUSH-PULL FOR A.F.

CLASS "AB" – "AB_1" – "AB_2"

AB_1 BIAS IS LESS THAN CUTOFF BUT MORE THAN "A" – I_p FLOWS MORE THAN 180° LESS THAN 360° FAIR SENSITIVITY – FAIR FIDELITY FAIR EFFICIENCY 30-50%

CLASS "AB_2" SAME AS "AB_1" BUT HAVING I FLOWING IN GRID

DUE TO LARGE SIGNAL. USED
N PUSH-PULL - LOW EFFICIENCY
SELDOM USED FOR R.F.

CLASS "C" BIAS AT TWICE OR
MORE CUTOFF. Ip FLOWS FROM
90° - 120° - USUALLY HAS GRID I.
GRID LEAK BIAS USED
VERY POOR SENSITIVITY. VERY
POOR FIDELITY. HIGH EFFICIENCY
60 - 80% - USED FOR SINGLE
ENDED STAGE. R.F AMPL.
ONLY. FOR POWER OUTPUT - USES
TUNED PARALLEL CKT FOR PLATE
LOAD. FREQUENCY MULTIPLIER
PUSH-PULL OUTPUT OF TRANSMITTER
R.F. AMPLIFIERS TO INCREASE
R.F SIGNAL. FREQUENCY SPECTRUM
OF R.F.
(1) - 20 Kc - 550 Kc MARITIME
(2) - 550 - 1650 - LONG WAVE - BROADCAST
1650 - 44 Mc - SHORT WAVE
44 Mc - 88 - T.V. 1 - 6 CHANNELS
88 Mc - 108 - F.M.
108 - 400 Mc. T.V 7 - 13 CHAN.
400 - 750,000 Mc. T.V. U.H.F RADAR
MICROWAVE ABOVE 750,000 Mc.
INFRARED - ULTRA GAMMA.
COSMIC - RAYS

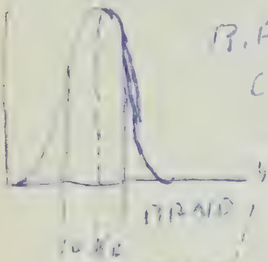
R.F AMPLIFICATION. ANY KIND "A" "AB" "B" "C"

MOST COMMON "C" - R.F AMPL.

RANGE - 15 KC TO 300 MC.

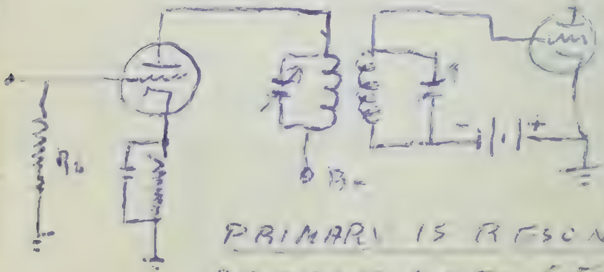
R.F AMPL. WIDE BAND FREQUENCY OR NARROW BAND - TUNED CKT IN R.F AMPL. HARMONIC DISTORTION NOT AFFECT R.F.

R.F. AMPL. IN RECEIVER VOLTAGE AMPL. R.F COUPLING NETWORK. TUNED CKT OR TUNED TRANSFORMER TO PICK UP AND DESIRED BAND AT FR. 10 KC ABOVE AROUND THE RESONANT FR.



R.F RESONANT CURVE.

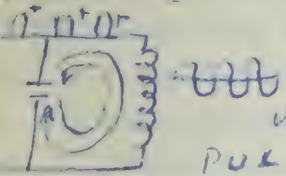
TRANSFORMER COUPLING IN R.F USES AIR CORE AND FEWER TURNS



PRIMARY IS RESONANT PARALLEL CKT. SECONDARY ACTS AS A SERIES RESONANT

AT RESONANCE MAXIM. I
TANK. MAX. Z IN LINE USED
AS POWER OR VOLTAGE AMPL.
TUNED TRANS. COUPLING EITHER
SINGLE OR DOUBLE ENDED. HIGH
EFFICIENCY IN PICKING RESONANT
FREQUENCY

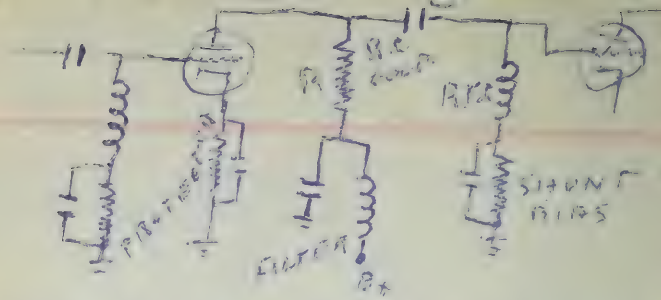
FLYWHEEL EFFECT IN A
TANK CKT MAKES UP FOR NE-
GATIVE CYCLE FOR CLASS
"B" OR "C" FED BY SHARP
POSITIVE PULSES.



I. KEEPS OSCI
LLATING IN TANK
WITH ONLY POSITIVE
PULSES APPLIED.

R.F. VOLTAGE AMPL.
USES: 1ST AMPL. STAGE OF RECEI
VER. - CLASS "A". SENSITIVE TO
WEAK SIGNAL. IN I.F. STAGES
FOR BUFFER STAGE IN TRANSMI
TTER. CLASSIFICATION ACCORDING
TO COUPLING - (1) R.C. COUPLING
ONLY OCCASIONALLY. WHEN NEED
FOR A WIDE BAND, PASS

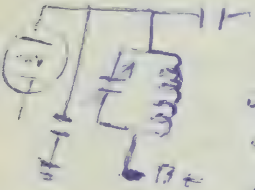
R.C COUPLED WITH SHUNT
FED GRID LEAK BIAS. PRO
TECTOR CATHODE BIAS
R.F CHOKE IN BIAS



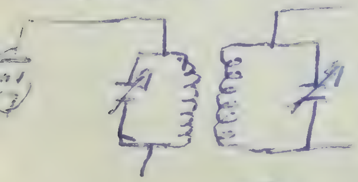
R.F. CHOKE TO HAVE LARGE IMPEDANCE IN GRID.

IMPEDANCE COUPLING TO PREVENT THE AMPLIFIER FROM BEING TOO SELECTIVE. WIDE BAND PASS. IN CKT INDUCTOR REPLACES RESISTOR.

TUNE IMPEDANCE USES VARIABLE CAPACITOR IN PARALLEL WITH INDUCTOR



MOSTLY USED IN TRANSMITTERS. OCCASIONALLY IN RECEIVERS. AT RESONANCE - THE PARALLEL TUNED CKT ACTS AS PURE RESISTANCE. —

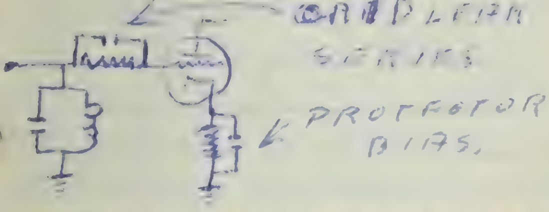


TRANSFORMER COUPLING USED IN RECIEVERS

TRANSFORMER TUNED

R.F. CLASS "C" USED FOR HIGH EFFICIENCY - FINAL POWER AMP. OF TRANSMITTER - FREQUENCY MULTIPLIER TUNED OUTPUT TO SECOND HARMONIC OR DOUBLE OF DOUBLE FREQUENCY PUT OUT BY OSCILLATOR - OSCILLATOR OPERATES AT CLASS "C"

UTILIZING GRID LEAK BIAS - ~~WHEN~~ WHEN OPERATIN "C" WE NEED GRID LEAK BIAS FOR IG TO FLOW IN POSITIVE BIAS. PROTECTOR CATHODE BIAS TO PROTECT THE TUBE IN CASE OF GRID LEAK WOULD OPEN IN BREAK, TO CONTROL IP FLOW.

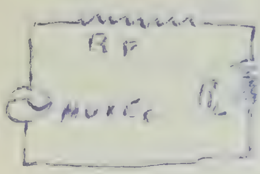


~~FINAL~~ FLYWHEEL EFFECT IN CLASS "C" SINE WAVE DISTORTED.

R.F POWER AMPLIFIER TUBES USED: TRIODE - INTER ELECTRODE CAPACITANCE AT HIGH FREQUENCIES. TETRODE PENTODE BEAM POWER TUBE CONNECTED

SINGLE ENDED OR PUSH PULL POWER AMPLIFIER WITH LOW PLATE RESISTANCE FOR

MAXIMUM POWER OUTPUT
MAXIMUM POWER TRANSFER



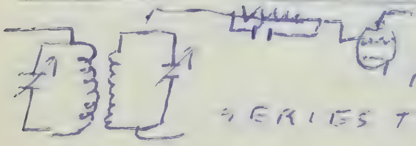
TANK CKT OUTPUT
AT RESONANCE
NOT MAXIMUM
Z

$$I_P = \frac{MU \times EG}{R_P + R_L}$$

MAXIMUM POWER TRANSFER AT RESONANCE OR LOAD MATCH WITH THE PLATE RESISTANCE

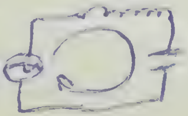
MU X EG	RP	RL	$I_P = \frac{MU \times EG}{R_P + R_L}$	$P = I_P^2 R_L$
100	10	5	6.6	215 W.
100	10	10	5	250 W.
100	10	15	4	240

TUBES CONNECTED SINGLE ENDED PARALLEL - PUSH PULL

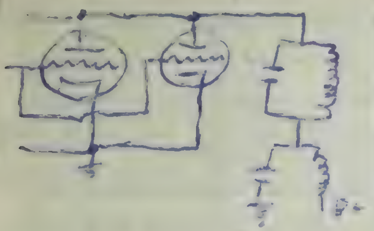


INPUT CKT ACTS AS A SERIES TUNED CKT

SO



PARALLEL TUBES SINGLE INPUT VOLTAGE. SINGLE ENDED. MORE POWER OUTPUT



PUSH PULL

DOUBLE ENDED
TWO VOLTAGES
180° OUT OF PHASE SAME VALUE

IMPEDANCE MATCHING R.F.

FOR MAXIMUM VOLTAGE

R_L 3 TO 10 TIMES THAN R_P

POWER - $R_L = R_P$. R.F. COUPLING CONSTANT - R.F. COUPLING VARIES

LOOSE COUPLING TIGHT COUPLING

EFFECTS OF COUPLING IN REFLECTED IMPEDANCE

$(Q = \frac{X_L}{R})$ TANK CKT. $(Z = \frac{X_L^2}{R})$ OR

$(Z = Q \cdot X_L)$ LOOSE COUPLING PRIM. AND SECOND. PLACED FARTHER APART. VERY SMALL REFLECTED Z. MEDIUM COUPLING - Q DECREASES REFLECTED R. INCREASES. HIGH (REFLECTED R. IN TANK) IMPEDANCE OF TANK DECREASES

TIGHT COUPLING - Q DECREASES MORE. Z MINIMUM

CLASS 'B' $Z = \frac{E \text{ (DC PLATE)}}{I \text{ (DC PLATE)}}$

$Z = Q \cdot X_L$ $Q = \frac{X_L}{R}$ $Q = \frac{Z}{L}$

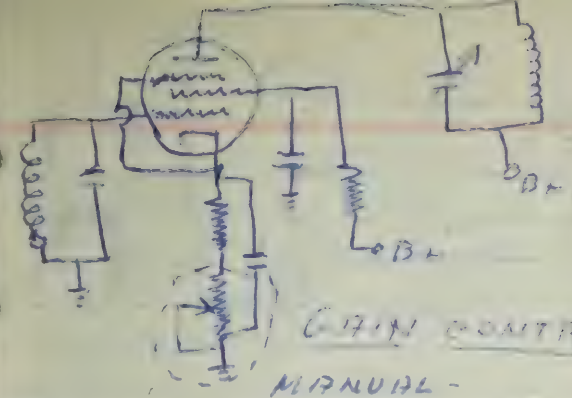
$X_L = \frac{Z}{Q}$

NEUTRALIZATION THE PROCESS OF BALANCING OUT THE UNDESIRABLE FEEDBACK BY INTERELECTRODE CAPACITANCE OF THE TUBE SO THAT FEEDBACK WILL CANCEL OUT THE GRID SIGNAL. PURPOSE TO PREVENT OSCILLATIONS IN AMPL. PLATE OR HAZELTINE NEUTRALIZATION CENTER TAP ~~[illegible]~~ PLATE TANK CKT TO OFFSET NEGATIVE FEEDBACK TO NEUTRAL POSIT. FEEDBACK.

GAIN AND OUTPUT CONTROL

CONTROL IS A DEVICE TO VARY THE GAIN OF AN R.F AMPL. BY CHANGING THE TUBE CHARACTERISTICS. USUALLY DONE BY VARYING THE BIAS ON A REMOTE CUTOFF TUBE. MANUAL OR AUTOMATIC

THREE CKTS IN GREEN SHEET



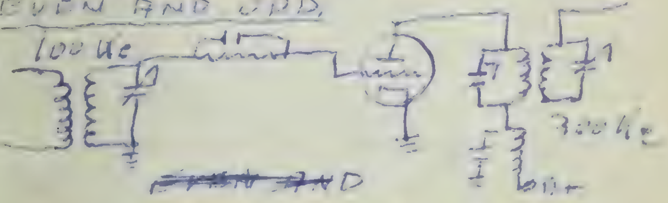
GAIN CONTROL

MANUAL -

FREQUENCY MULTIPLIERS AN AMPL. THAT AMPLIFIES A HARMONIC IN TRANSMITTERS. SIGNAL GENERATOR - CONDICTIONS REDUCTION OF HARMONICS.

TRANS SIGNAL THRU "C". STRONGER BIAS THAN "C". OUTPUT ~~T~~ TRANSFORMER TANK CKT. TUNED TO THE DESIRE ~~FR.~~ HARMONIC

SINGLE ENDED FR. MULTIPLIER PRODUCES ALL HARMONICS EVEN AND ODD.

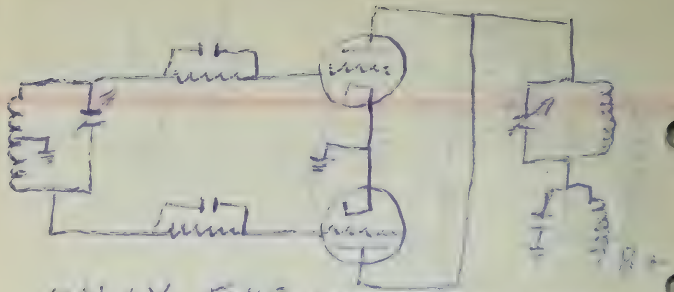


~~[illegible] AND~~

ODD HARMONICS PUS PULL

PUSH-PUSH FR. MULTIPLIER

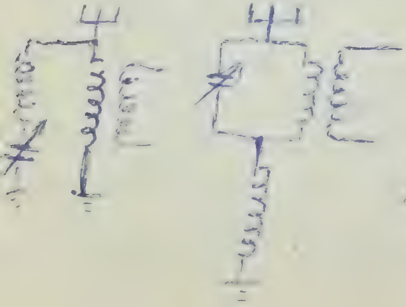
ONLY EVEN - HARMONICS



ONLY EVEN HARMONICS

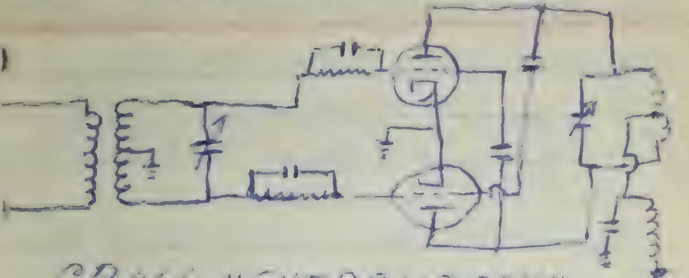
PUSH-PUSH.

R.F. FILTERS TO KEEP R.F. OUT OF POWER SUPPLY. DECOUPLING FILTERS. ~~LOW PASS~~ TO PICK OUT ONE DESIRED FREQUENCY AND REJECTS OTHERS. CAPACITORS FOR BYPASSING TO COUPLE TRANS. TO GROUND FR. PREVENT OSCILLATION AND FEEDBACK. LOW PASS. PASSES LOW FR. BAND PASS PASSES A DESIRED BAND OF FR. - BAND REJECT IN TRANSMITTERS TO PREVENT HARMONICS FOR BEING SEND OUT



BAND REJECT FILTERS IN TRANSMITTERS

R.F. PUSH PULL POWER AM-
PL. IN TRANSM. FR. TRIPLER



CROSS NEUTRALIZATION
IN PUSH-PULL.

OSCILLATORS, TRANSMITTER
ANTENNAS.

OSCILLATORS - OSCILLATING IN
TANK CKT TO GENERATE A.C AND
MAINTAIN A CONSTANT FR.
(LESS OSCILLATIONS MORE I_p)
DAMP OSCILLATIONS CAUSED BY
RES. OF CKT.

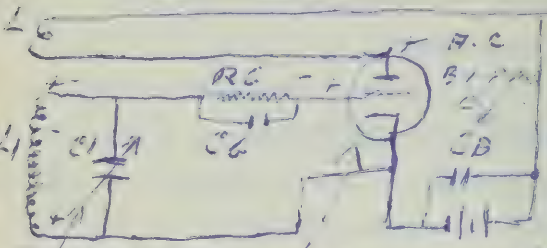
FEED BACK TO KEEP OSCILLA-
TIONS AT SAME AMPLITUDE
(SUFFICIENT AND IN PHASE
POSITIVE). FEED BACK COUPLING
METHODS (1) INDUCTIVE (2)
CAPACITIVE (3) INTERELECTRODE
CAPACITANCE. VACUUM TUBE DON'T
[illegible] OSCILLATE. IT SERVES AS
[illegible] AND ELECTRONIC SWITCH.
FRE. OF OSCILLATIONS IS THE NUM-
BER OF TIMES "C" CHARGES
AND DISCHARGES IN TANK.

VALUE OF "C" & "L" DETERMINES FREQUE. OF OSCILLATIONS. THE FR. OF OSCILLATIONS IS INVERSELY RELATED TO "C" & "L"

$F = \frac{.159}{\sqrt{L \times C}}$

TIKLER COIL AND FR. OF OSCILLATIONS

TIKLER COIL FEEDBACK OSCILL.



L - TIKLER

L1 - TANK COIL

C1 TANK CAPACITOR

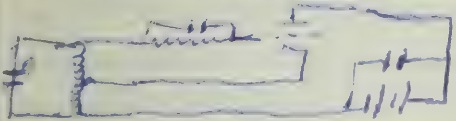
PHASE REVERSAL

AT THE START NO GRID. Ip FLOW TO "L" INDUCING A ~~CURRENT~~ VOLT. (FEEBACK) IN "L1" KEEPS UP TILL SATURATION POINT. GRID POSITIVE. "C1" CHARGE. INDUCED VOLT. DECREASES. C1 DISCHARGES PHASE REVERSAL GRID BECOMES NEGATIVE. Ip GOES DOWN. C1 CHARGES OPOSITE. "L" INDUCES NEGATIVE VOLT. IN L1 - GRID AT CUTOFF. NO INDUCED VOLT. "C1" DISCHARGES - GRID LESS NEGATIVE. Ip STARTS TO FLOW COMPLETE CYCLE. WHEN POWER IS NOT ... THERE-

IS NO GRID POTENTIAL. WE CHECK FOR OSCILLATIONS BY MEASURING GRID CURRENT AND VOLTAGE. NONE NO OSCILLATIONS. I_p GREATER IF THERE IS NO GRID. I_p LESS-LESS INDUCED VOLTAGE IN TANK

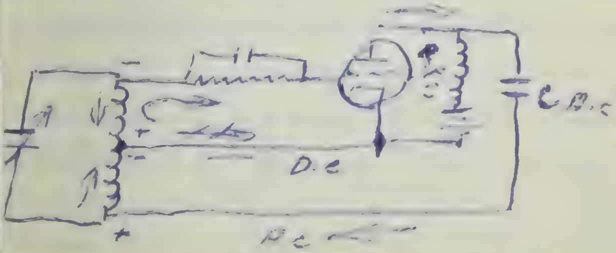
OSCILLATORS MUST USED GRID LEAK BIAS FOR SELF STARTING WITH GRID LEAK OPERATION. AND STABLE OPERATION

HARTLEY "SERIES" AND "SHUNT" FED OSCILLATORS. HARTLEY SIMPLIFIED TUNER USING A CENTER TAP AUTOTRANSFORMER. INDUCTIVE FEEDBACK.



HARTLEY SERIES FED.

SERIES ONLY ONE PATH FOR FOR D.C AND A.C FROM PLATE:

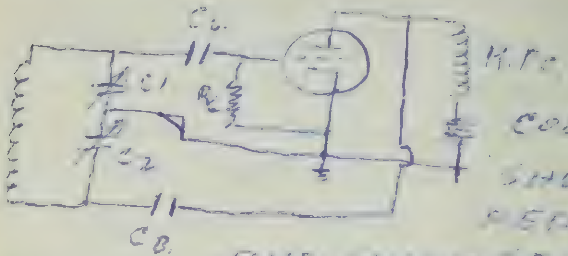


HARTLEY SHUNT. TWO PATHS R.F. CHOKE FOR D.C. "C" FOR A.C. KEEPS HIGH D.C.

FROM COIL - R.F.C. ... FROM P.S.

COLPITTS OSCILL. ...

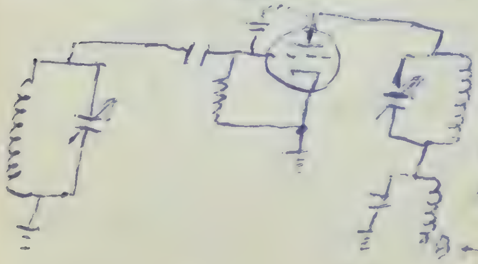
HARTLEY BUT USE TAP CAPACITORS INSTEAD OF TAP TRANS. CAPACITANCE FEEDBACK



COLPITTS SHUNT FED AND SHUNT GRID RETURN. C_1 GRID CONTROL ... C_2 FEEDBACK CONTROL ... SHIFT IN CENTER TAP RELATIVE VOLTAGE ... "C_1 + C_2"

$$\frac{\uparrow E_{C_1}}{\downarrow E_{C_2}} = \frac{C_2\uparrow}{C_2\downarrow}$$ VOLTAGE INVERSE TO CAPACITANCE

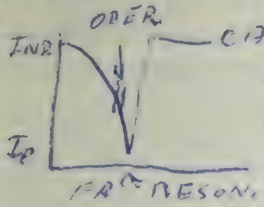
TUNED PLATE AND GRID OSCILL. INTERELECTRODE FEEDBACK



GRID TUNED FOR ~~MAXIMUM~~ MAXI

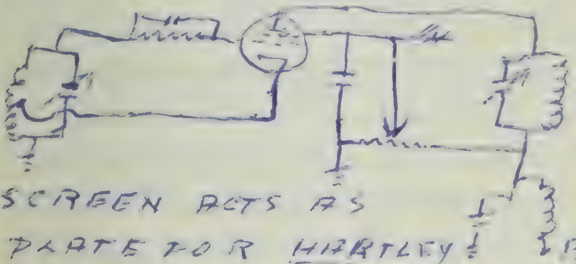
PLATE TUNED FOR ~~MAXI~~ ~~MUM I~~ MINIMUM I

BOTH GRID AND PLATE TANK MUST BE TUNED TO A FR. SLIGHTLY HIGHER THAN OPERATION FR. NATURAL FR. IS DETERMINE BY THE "Q" OF EITHER TANK. "Q" - RATIO OF REACTANCE TO RESISTANCE.



CAPR. READ I_p TO MINIMUM THEN A LITTLE INDUCTIVE.

<u>ELECTRON COUPLE OSCIL</u> TO MINIMIZE EFFEC OF LOAD ON FR. MORE STABLE THAN ANY [illegible] ION CRYSTAL OSCILL. OSCILL. AND AMPL. SELF STARTING.



SCREEN ACTS AS PLATE FOR <u>HARTLEY</u> OSCILL. PLATE TANK TUNED AT FOR AMPLI. TETRODE TUBE PLATE LOAD DON'T EFFEC OSCILL. FR. OF OSCILL. CAN BE MADE SUBSTANTIALY INDEPENDENT OF SUPPLY VOLTAGES VARIATION

CRYSTAL OSCILL. MOST SATISFACTORY TO HOLD FR. AT A DEFINITE VALUE.

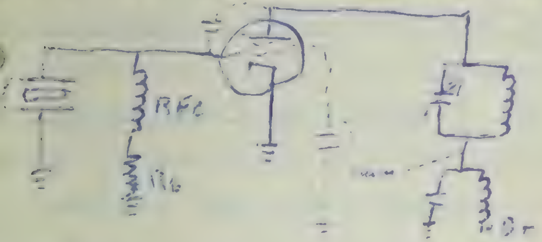
PIEZOELECTRIC EFFECT WHEN A CRYSTAL IS PLACED BETWEEN METALIC SURFACES WITH DIFFERENT POTENTIAL THE XTAL EXPANDS AND CONTRACTS PRODUCING VARIATIONS IN A.C. TRUE TUBE IN TRANSMIT. VERY SMALL FEEDBACK NEEDED. AT RESONANT FR. LARGE VOLTAGE. RESONANT FR. WHEN THE FR. OF A.C VOLT. IS EQUAL TO FR. OF XTAL.

KIND OF XTALS QUARTZ - ROCHELLE SALTS - TOURMALINE QUARTZ NOT MECHANICAL STR.

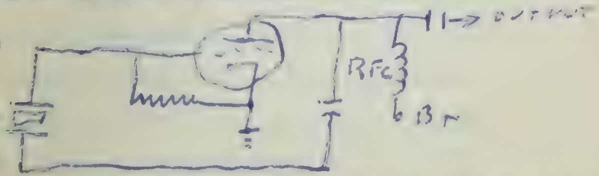
LOW TEMPERATURE COEFFICIENT THE TYPE OF CUT DETERMINES THE TEMPERATURE COEFFICIENT "X" CUT NEGATIVE COEFFICIENT INCREASE OF TEMP DECREASES FR. "Y" CUT POSITIVE COEFFICIENT INCREASE OF TEMP INCREASE OF FR. "AT" AND "BT" CUT NO EFFECT IN TEMPE. THICKNESS OF XTAL DETERMINES THE FR. OF XTAL

AT RESONANCE THE XTAL
OSCILLATOR ACTS AS A
TUNED CKT. SYMBOL

THE XTAL OSCILLATOR.
TUNED PLATE WITH TRIODE
OR TETRODE. USES INTER
ELECTRODE FEEDBACK
TETRODE CUTS DOWN THE
AMOUNT OF FEEDBACK



EXTREMELY SHARP AT RESONANCE
BUT LOW OUTPUT DUE TO HEAT
ING AND DANGER OF BREAKING
OF XTAL - FIXED FREQ. XTAL
PLATES ACT AS "Cg"
PIERCE OSCILL. VERY STABLE
NO TUNING REQUIRED.



INTERELECTRODE CAPACITANCE
FEEDBACK. USED IN MEASURING
INSTRUMENTS.

FR. DRIFT CONCERN IN OSCILL.

(1) HEATING OF CUT (A) XTAL (B) TUNING ~~CUT~~ CAPACIT. IN ~~TAN~~ TANK. (C) INDUCTANCE IN GRID TANK (D) INTERELECTRODE CAP. (WARMUP TIME ELIMINATES ALL OF THEM) (2) DRIFT OF B+ (VOLTAGE RADIANT TUBES) WELL REGULATED POWER SUPPLY. (3) HUMIDITY AFFECTS THE TUNING CAPACITORS.

THE C W TRANSMITTERS

SUPPLY POWER FOR RADIATIONS SEND OVER THE ANTENNA.

C.W. - CONTINUOUS CONSTANT AMPLITUD AND CONSTANT FR.

SIMPLE TRANS: (1) OSCILLATOR (2) POWER SUPPLY (3) KEY (4) ANTENNA. LOW OUTPUT. POOR STABILITY. ~~OSC~~ OSCILLATOR CONNECTED DIRECT~~ED~~ TO ANTENNA

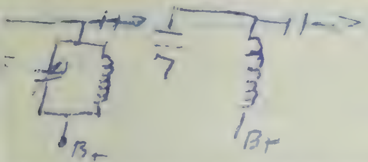
POWER AMPLIF. TRIODE DON'T HAVE TO BE NEUTRALIZED IF IS ACTING AS A FR. MULTIPAIER. BUFFER VOLTAGE AMPLIF. SEPARATES OSCILLAT. BUFFER (IDEAL OPERATION IN CLASS "A") FOR SENSITIVITY "B" OR "C" FOR EFFICIENCY

INTERSTAGE COUPLING

R.F + A.F

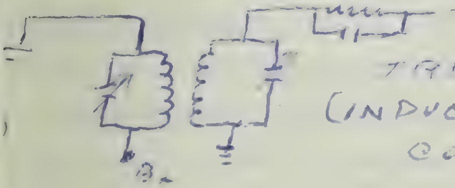
R.F (1) IMPEDANCE COUPLING

) NOT SELECTIVE - PASSES HAR-
MONICS, CAUSES INTERFERENCE.
DANGER OF HIGH D.C. SHOR-
TING OF CAPACITOR AND PUTS
B+ IN [illegible] [illegible]
LOSS DUE TO [illegible] ENER-
GY. LOSS OF SIGNAL [illegible] AND
) [illegible] ADOPT SMALL [illegible]



IMPEDANCE
COUPLING

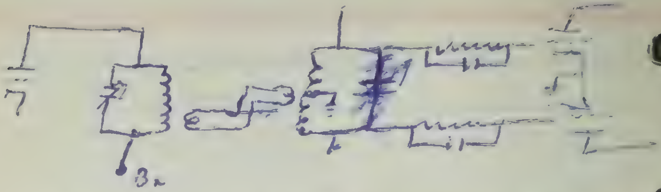
TRANSFORMER COUPLING
(INDUCTIVE) . VERY SELECTIVE
PHYSICAL SEPARATION BETWEEN
STAGES - MINIMUM RADIATION
LOSS - BULKY - COSTLY



TRANSFORMER
(INDUCTIVE)
COUPLING

LINK COUPLING LINK AT
) ANGLE TO MINIMIZED THE
DISTRIBUTED CAPACITANCE -
COUPLE BETWEEN TWO POINTS
OF LOW POTENTIAL R.F

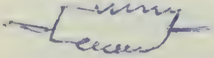
DISTANCE BETWEEN STAGES MAY BE WIDE.



LINK COUPLING WITH PUSH-PULL

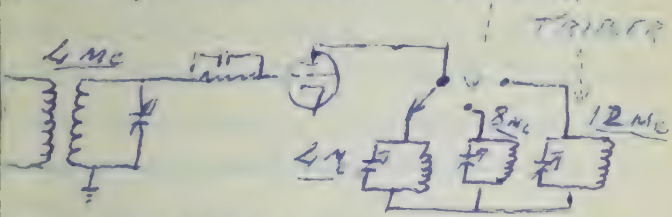
NEUTRALIZATION AND PARASITIC OSCILLATIONS NEEDED, IN TRIODES IN R.F AMPL. AT HIGH FR. FOR FEEDBACK (INTERELECTRODE CAPACITANCE) WHICH MAY CAUSE OSCILLATIONS - HAZELTINE, RICE AND CROSS NEUTRALIZATION (SEE ABVE DIAGRAM)

FR OF GRID TANK = FR. OF TANK PLATE. PARASITIC OSCILLATION, INTER. OSCILLAT. AT OTHER THAN OPERATING FR. IN R.F. AMPL. (1) CAUSED BY DISTRIBUTED INDUCT. AND CAPAC. (2) LOWER EFFICIENCY - POWER CONSUMED IN HEAT IN CKTS. (3) SPURIOUS TRANSMISSIONS EXTRA FR. PREVENTION; DON'T REARRANGE CKT. - PARASITIC SUPRESSORS



FR. MULTIPLICATION - NEED
F BECAUSE XTAL LIMITED TO
PROXI. 20 Mc. THICK IN INCHES =
.77 = THICKNESS OF XTAL
F Mc

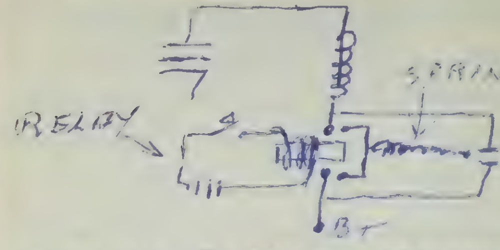
FR. MULTIPLIERS ALLOW AD-
DITIONAL BANDS OF OPERATION
FOR 1 OSC. FR. DOUBLER



SINGLE ENDED MULTIPLIER
FOR ODD AN EVEN HARMONICS
CLASS "C" R.F AMPL. TUNED
PLATE AND GRID CKT. USES TE-
TRODES AND PENTODES - MORE
DISTORTION THUS STRONGER
HARMONICS. PUSH PULL FOR
ODD HARMONICS MULTIPL.
PUSH PUSH FOR EVEN.

METHODS OF KEYING KEY
TO ADD INTELLIGENCE TO CW.
METHODS IN ANY OF THE ELE-
MENTS OF TUBE TO STOP
OPERATION. PLATE AND
GRID MOST COMON - PLATE
CUTOFF B+ - GRID - CONTROL
EP

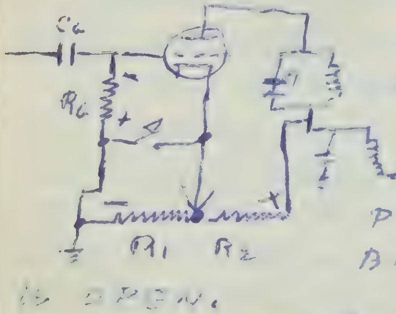
PLATE KEYING USING THE RELAY AND FILTER FOR KEY CLIKS OR DISTORTION



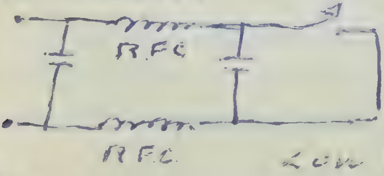
RELAY KEYING - REMOTE KEYING

BACKWAVE RADIATION WHEN KEY IS OPEN CAUSED BY IMPROPER NEUTRALIZATION. MAGNETIC COUPLING BETWEEN STAGES. INCOMPLETE KEYING

GRID BLOCKING KEYING KEY OPEN. HIGH NEGATIVE VOLTAGE ON GRID CUTS OFF TUBE.



LARGE RESIST DEVELOPS LARGER VOLTAGE DROP B+ DEVELOPING NEGATIVE BIAS, WHEN KEY IS OPEN.

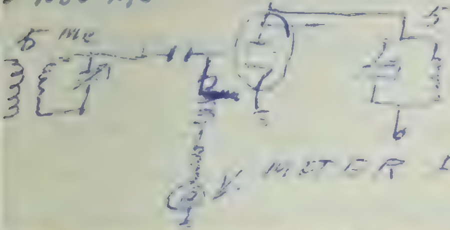


KEY FILTER FOR KEY CLIKS.

LOW PASS FILTER

TUNING THE C.W. TRANSMITTER - R.F AMPLIF

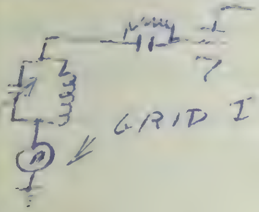
GRID TUNING CKT ACTS AS A SERIES TUNED CKT. AT RESONANCE LOWEST Z MAXIMUM I IN GRID. PLATE TUNING CKT PARALLEL TUNED MAXIMUM Z LOWEST I_p SO AT RESONANCE TUNED GRID I AT MAXIMUM AND I_p MINIMUM.



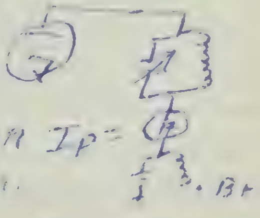
AT RESONANCE

METER FOR GRID

TESTING FOR GRID I



GRID I MAXIMUM



METER FOR I_p MINIMUM.

EXCEPT IN PLATE OF OSCILLATORS. XTAL & TUNED GRID-PLATE CKTS. I_p SLIGHTLY MORE THAN MINIMUM.

AMPLITUD MODULATION ON AUDIO COMPONENTS

A.M IS VARING THE AMPLITUD OF THE R.F WAVE TO AN AUDIO RATE. CARRIER FR. MUST BE CONSTANT, AMPLITUD VARIES WITH AUDIO FREQ.

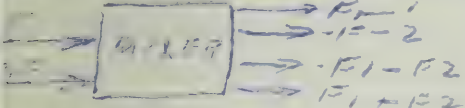
AUDIO AMPL. IS AN A.F VOLTAGE AMPLI. STEPS UP OUTPUT FROM MIKE. CLASS "A" CATHODE RESISTOR BIAS MAY BE FIXED BIAS SOMETIMES MORE THAN ONE STAGE.— MODULATOR A.F POWER AMPL. CLASS "A" (AB OR "B" IN PUSH PULL) FIXED BIAS - SOMETIMES CATHODE BIAS. AMPLIFIES AUDIO BEFORE MODULATE WAVE - MIKES CARBON GRANULATED PULSATING CAUSED BY SOUND PRODUCES A D.C. RESULTS DC VOLTAGE. RESIS. IN THE CARBON GRANULES VARIES WITH SOUND SO: YELL R↓ I↑ WISPER R↑ I↓ HIGH OUTPUT.

DYNAMIC MIKE IS AN A.F GENERATOR. PERMANENT MAGNET. DON'T NEED OUTSI

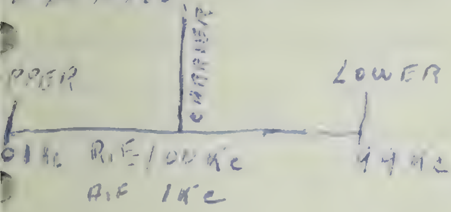
POWER . LOW OUTPUT

SIDE BANDS AND % MODULATION

MIXING = HETERODYNE IS MIXING 2 ~~FR~~ SIGNALS OF DIFFERENT FR.—WHEN MIXING R.F AND A.F FRE. ARE PRODUCED (R.F IS THE CARRIER) SIDE FR. A GROUP OF SIDE FR. IS CALLED SIDE BANDS. THIS BANDS ARE IN BOTH SIDES OF THE CARRIER FR.



UPER SIDE BANDS ARE THE R.F PLUS THE MODULATED FR. LOWER SIDE BANDS ARE THE R.F MINUS THE MODULATED FR.



A MODULATED FR. EQUALS A CHANNEL OR BANDWITH OF FR EQUAL TO 2 TIMES THE ~~MODULATED FR.~~ HIGHEST MODULATED FR.

LOWER | UPPER

1998 — R.F 2,000 KC — 2002

AUDIO 2 KC

$$\begin{array}{r} 2002 \\ 1998 \\ \hline 0004 \text{ KC} \end{array}$$

B.W = 4 KC.

B.W VARIES WITH FR. COMING OUT OF ~~AUDIO~~ MIKE. THE POWER OF THE SIDE BANDS IS DETERMINED BY THE % OF MODULATION. FOR 100% MODULATION THE SIDE BAND POWER IS 1/2 OF CARRIER POWER. 100% MODULATION IS DRIVING THE AMPLITUDE OF CW TO DOUBLE THEN TO ZERO. % OF MODULATION IS THE CHANGE OF VARYING OUTPUT COMPARED TO CW AMPLITUDE. - IF THE AMPLITUDE IS LESS THAN DOUBLE THE CARRIER - MODULATION IS LESS THAN 100%

EQUATIONS FOR % MODULATION USING PEAK AND MINIMUM VALUES OF OUTPUT.

$$M = \frac{E_{MAX} - E_{MIN}}{E_{MAX} + E_{MIN}} \times 100$$

CURRENT I CAN ALSO BE USED

$$M = \frac{\text{PEAK R.F VOLTAGE}}{\text{B+ APPLIED TO R.F}} \times 100$$

90% = PEAK R.F = R.F BY
90% DESIRED MODULATION
PEAK A.F MUCH SMALLER
THAN R.F. BY UNDER MO-
DULATE. WHEN SIGNAL - LOW
LEVEL TO NOISE RATIO
LESS DISTORTION FROM THE
STATIONS IN ADJACENT CHANNEL
OVER MODULATION OCCURING

DISTRIBUTE POWER

AUDIO POWER IS THE POWER
THAT IS IN THE SIDE BANDS
AUDIO PW = $\frac{1}{2}$ OF CARRIER PW
AUDIO PW = SIDE BANDS
LOW AND UPPER SIDE BANDS
EACH HAVE $\frac{1}{2}$ OF AUDIO POWER
FOR AUDIO TRANSMIT NEED
50% MORE POWER THAN
PW
TOTAL RADIATED POWER
TRP = CARRIER + AUDIO

FRACTIONS

T.R.P ~~CARRIER~~ = $\frac{TRP}{CARRIER}$ = $1\frac{1}{2}$ OF CARRIER

AUDIO = $\frac{AUDIO}{TRP}$ = $\frac{1}{3}$ OF T.R.P

CARRIER $\frac{2}{3}$ OF T.R.P.

AUD. 2 SIDEBANDS = 1/3 OF T.R.P

1 SIDE BAND = 1/6 OF T.R.P.

ANTENNA CURRENT

ANTENNA CURRENT INCREASES WITH % MOD INCREASES

THUS

C.W. = 100 W

R = 1 Ω

ANT. I = 10 MA.

$P.W = I^2 \times R$

100 % MOD.

C.W + AUD.

100 + 50 = 150 W.

$I_{ANT.} = \sqrt{150} =$ 12.25 M.A

ANTENNA I INCREASES 22.5 % MAXIMUM.

INCREASE OUTPUT AS AN % OF MODUL. INCREASES.

IN TUNED TRANSMITTER

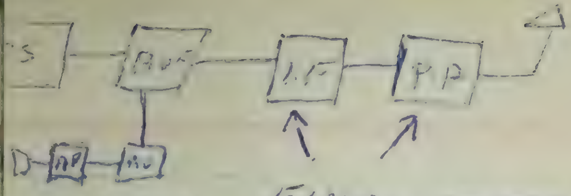
I_p MAX. I_G MINIMUM $I_{AN.}$ MAXIM. DETUNED TANK

I_p DECREASES – I_G INCREASES

REDUCED LOAD I_p DECREASES I_G INCREASES – $I_{ANT.}$ DECREA.

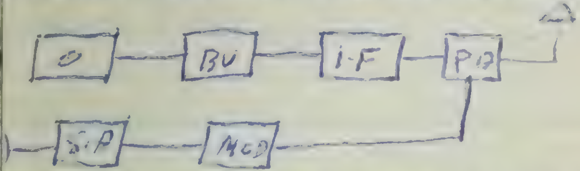
MODULATION METHODS – VARIABLE ELEMENT. (ALL ELEMENTS OF PENTODES CAN BE USED FOR MODULATION) METHOD NAMED AFTER ELEMENT OF R.F TUBE RECEIVING THE R.F VOLTAGE.

POWER LEVEL OF R.F STAGE LOW AND HIGH POWER MODULATION



FINAL STAGES

OW LEVEL
MUST BE LINEAR - MUST
HAVE GOOD FIDELITY - CLASS
"AB" OR "B" PUSH-PULL - POWER
TPUT MUST BE ADEQUATE



IGH POWER MODULATION
INAL STAGE MODULATED
LASS "C" FOR HIGH OUTPUT
LATE MODULATION TRANSFOR-
MER COUPLED

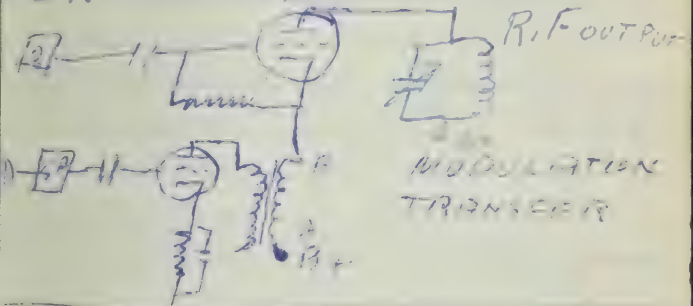
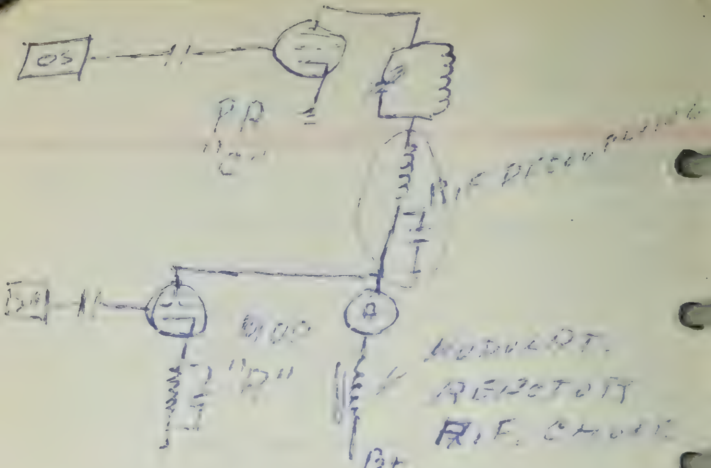
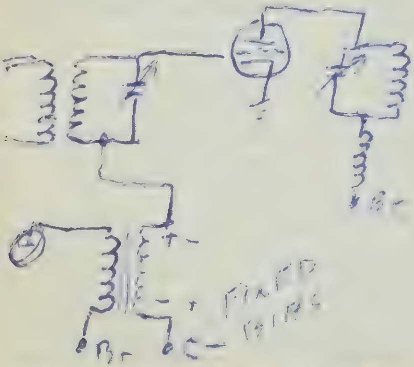


PLATE MODULATION - HEISING
CHOKE - CONSTANT CURRENT
THE AMP METER READS
MODULAR. P A R.F.



INCREASE IN Ip(AUDIO) DECREASE Ip(R.F) CAN'T OBTAIN 100% MOD. ONLY 80 TO 90% - TRANSFORMER COUPLE MOST EFFICIENT TYPE OF MODULATION

GRID BIAS MODULATION



POOR EFFICIENCY
SMALL AUDIO VOLTAGE REQUIRED

M.C.W (MODUL. C.W) METHOD OF USING CODE - USING A.M. DOESN'T NEED B.F.O IN RECEIVER

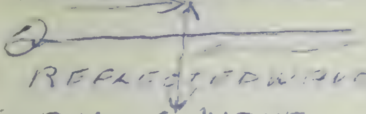
ANTENNAS

TRANSMITTERS — TRANSMISSION LINE — ANTENNA

R.F. SPEED
186,000 MILES
984,000,000 FEET
300,000,000 METERS

WAVELENGTH = $\lambda = \frac{V}{F}$

INCIDENT WAVE



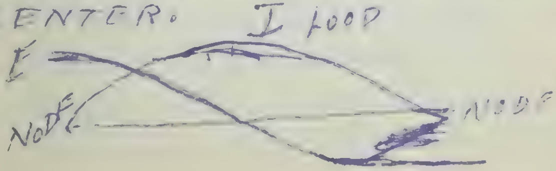
REFLECTED WAVE

STANDING WAVE

50 KC GAIN OF EFFICIENCY ON ANTENNA IS EXPERIENCED BY A TUNED CKT. HAS INDUCTANCE AND CAPACITANCE

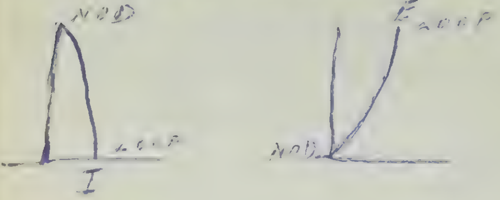
WAVELENGTH - HERTZ ½ WAVE ; MARCONI ¼ WAVE - VERTICAL

STANDING WAVE RADIATION IN HERTZ I FLOWS FROM END TO END. I MAX. AT CENTER. MINIMUM AT END (I-LOOP). (I-NODE) VOLTAGE MAXIM. AT END MINIMUM AT CENTER.



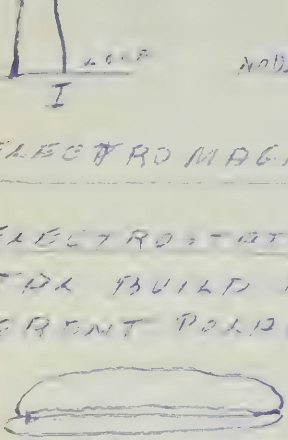
APPROX: I ~~FEW~~ FLOW
FROM TOP TO GROUND

I MAX AT GROUND MINIMUM
AT TOP VOLTAGE MAXIM.
AT TOP MINIM AT GROUND



ELECTROMAGNETIC FIELD

ELECTROSTATIC FIELD HORIZON-
TAL BUILD BY VOLTAGE DIFF-
ERENT POLARITY IN ANTENNA



MAGNETIC FIELD CAUSED
BY CURRENT IN ANTENNA
VERTICALLY

INDUCTIVE
RADIATED

POINT OF RADIATION FREQ-
UENCY 50 KC OR ABOVE.

POLARIZATION THE RECEIV-
ING ANTENNA MUST BE
IN THE SAME PLAIN THAT
THE SENDING

ANTENNA TYPES

SE A HERTZ WHEN
OT NEED A VERY LARGE
NTENNA - USE A MARCONI
WHEN NEED FOR A LOW
ED FREQ- MUST BE GROUN-
DED.
COUNTERPOISE SIMULATED
GROUND FOR MARCONI AN
ENNA USING CAPACITY GRO
ND. USED IN MOBILE EQUIP
MENT.
ADDING INDUCTANCE IN SE
RIES TO ANTENNA. ACTS
ONGER WAVELENGTH.
ADDING CAPACITANCE IN
SERIES - ACTS AS A SHORTER
AVE LENGTH - IN PARALLEL
REVERSE. TOP LOADING
IS ADDING CAPACITANCE
WITH GROUND. DUMMY
ANTENNA. TO REDUCE RA
DIATIONS AND ACT AS LOAD
TRANSMISSION LINES AND
FEEDERS. TYPES OF LINE
TWIN LEAD. COAXIAL CABLE
TWISTED PAIR SINGLE
WIRE. (GROUND)
CHARACTERISTIC IMPE
DANCE. IS THE RESISTAN
E OF THE LINE, SIZE OF

WIRE AND LENGTH - HERTZ 72 TO 300 Ω. MARCONI 36 TO 300 Ω

MATCH LINE. POWER TRAVELS ALONG THE LINE TILL THE LOAD CONSUMES IT. CHARACTERISTIC IMPEDANCE NON-RESONANT LINE.

MISMATCH. RESONANT LINE NOT ENDED WITH ~~[illegible]~~ CHARACTERISTIC IMPEDANCE. THE LINE IS FED AT POINT OF LOW IMPEDANCE

LOW Z POINT HIGH I POINT

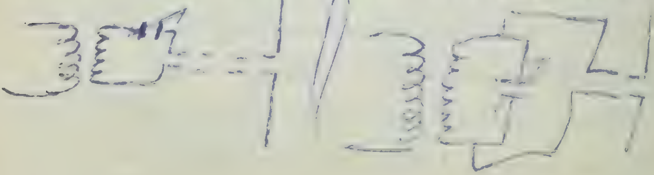
COUPLING AND TUNING

TRANSFORMER COUPLING

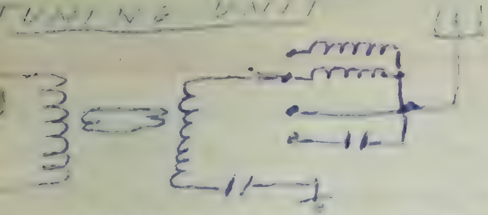
LINE MADE OF EVEN NUMBER OF 1/4 WAVE LENGTHS LOW IMPEDANCE AT ANTENNA

SERIES TUNED CKT IS USED WITH EVEN NUMBER OF 1/4 WAVELENTHS.

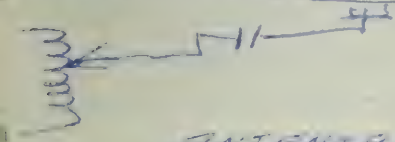
PARRALELL WITH ~~[illegible]~~ ODD - HIGH Z IN LINE LOW Z AT ANTENNA POINT



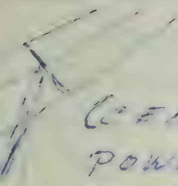
LINK COUPLING WITH
TUNING UNIT



CAPACITOR COUPLING



ANTENNA ARRAYS
DIRECTION CONTROL



DRIVER ELEMENT
(CENTER) GETS ITS
POWER FROM TRANSMIT.
REFLECTOR (BACK)
(PARASITIC ELEMENT) GETS
IT'S POWER FROM DRIVER. 5%
LONGER THAN DRIVER. 1/2
WAVELENGH AWAY FROM CENT.
CUTS DOWN BACK RADIAT.
INCREASES FORWARD. DIREC
TOR (FRONT) 5% SHORTER
1/8 TO 1/10 WAVE LENTH AWAY

DRIVEN ARRAYS SEVERAL
ANTENNAS ALL ELEMENTS
GET POWER FROM ~~POWER~~ TRANS
MITER. ADD AND CANCEL SIGNAL

DETECTORS AND RECEIVERS:

DETECTION OR DEMODULATION IS A PROCESS OF REPRODUCING TRANSMITTED INFORMATION FROM A MODULATED R.F. WAVE AND (DEMODULATION) EXTRACTING THE INTELLIGENCE FROM THE CARRIER BY RECTIFYING THE AUDIO ENVELOPE AND FILTERING THE R.F. FILTER USES CAP. AND RES.

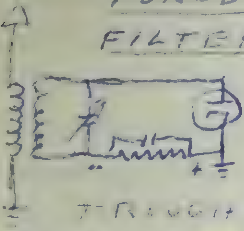
TYPES OF DETECTORS FOR A.M.
(1) DIODE DET. (2) GRID LEAK DET. (REC. AMPL. FILTER-TRIODE), (3) REGENERATIVE DET. (4) PLATE DET. (TRIODE-V.T.V.M.) (5) C.W. HETERODYNE DET. (REGENERATIVE)

DIODE DET: SENSITIVITY, SELECTIVITY, FIDELITY, SIGNAL HANDLING ABILITY

SENSITIVITY: A MINIMUM SIGNAL INPUT VOLTAGE THAT WILL DELIVER A STANDARD SIGNAL OUTPUT.
SELECTIVITY: THE ABILITY TO PICK OUT THE DESIRED FR. FROM ALL OTHERS. FIDELITY: THE ABILITY TO AMPL. A BAND OF FR. WITH MODULATION WITHOUT DISTORTION. SIGNAL HANDLING ABILITY (S.H.A.)

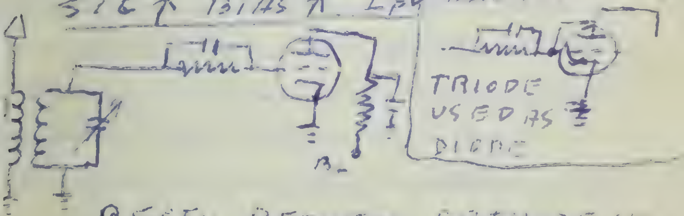
THE ABILITY TO HANDLE LAR-
GE SIGNALS WITHOUT OVERLOAD
ING. RECTIFY WITHOUT DISTORTION

DIODE DET. GOOD LINEARITY
TUNED CKT-SELECTOR-
FILTER CKT. CAP. R.F



BY-PASS. BLOCKS
OUT R.F. PASS
THE AUDIO PORTION
THROUGH R - RESISTOR -
DIODE COND. "I" ACROSS "R"
DEVELOPS VOLTAGE DROP FOR
OUTPUT. NO B+ NEEDED
CHARACTERISTICS: SELECTIVIT
Y "POOR" DUE TO LARGE LOA-
D "R" DAMPS RESONANCE OF
CKT. SENSITIVITY: POOR NO
AMPLIF. NO GAIN. S.H.A.
VERY GOOD. FIDEL. GOOD

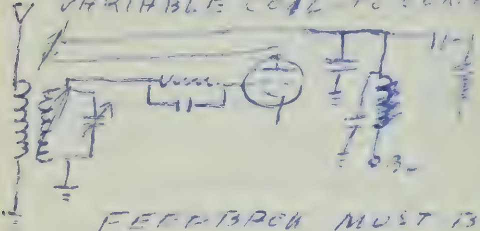
GRID LEAK DET: (TRIODE)
SIG ↑ BIAS ↑. Ip↓ AND VICE VERSA



RECT. BETWEEN CATHODE AND
GRID: AMPL. BETWEEN CATHODE
AND PLATE. OVERLOADS EASILY
WITH STRONG SIGNAL (DISTORTION)
CHARACTERISTICS: SENSITIVITY

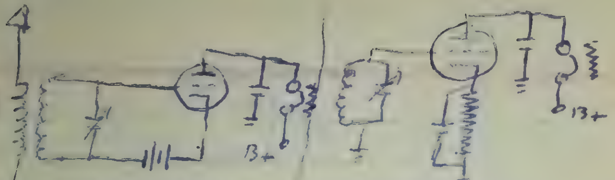
GOOD. SELECTIVITY FAIR.
S.H.A. POOR. FIDEL. FAIR.
GRID CAP. AND RES. ACT AS
FILTERS.

REGENERATIVE DET. (POSITIVE
FEED BACK). COMBINES THE
PRINCIPLE OF TICKLER COIL FEED.
AND GRID-LEAK DET.
REGENERATION IS A PROCESS
OF FEEDING PART OF THE OUT
PUT OF THE TUBE BACK TO THE
INPUT IN ~~...~~ PHASE WITH THE
VOLTAGE SO IT REINFORCES
THE GRID EXCITATION THEREBY
GIVING AMPLI. AND HIGHER
VARIABLE COIL TO CONTROL FEEDB.



FEEDBACK MUST BE CONTROL.
TO MUCH FEEDBACK WILL CAUSE
OSCIL. CAPACIT. IN PLATE CIR.
INDUCTIVE. TWO COILS SEPARATED
CHARACTE. SENSITIVITY- EXCEL.
SELECTIVITY- EXCELENT.
S.H.A. POOR FIDELITY
FAIR.

PLATE DET:



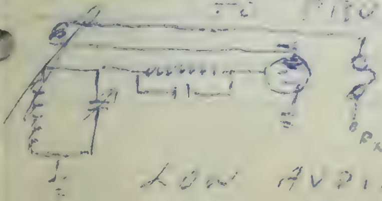
FIXED BIAS   LARGE ENOUGH BIAS
TO OPERATE NEAR CUT OFF

FIXED BIAS OR CATHODE BIAS - A CLASS "A"-"AB" NEAR CUTOFF. AMPLIFIES POSITIVE 1/2 OF CYCLE. DRIVING GRID AND NEGATIVE - I_p FLOWS - SIG ↑ BIAS ↓ I_p ↑ CHARACTERISTIC SENSITI PRETTY GOOD - SELECTI GOOD SHR. GOOD - FIDEL. GOOD

C.W. DETEC (HETRODYNE)

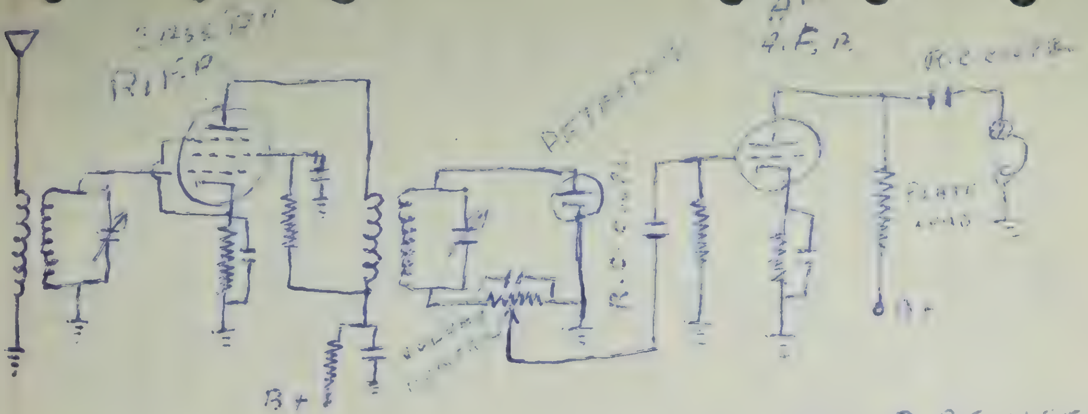
HETRODYNING - BEATING OR MIXING TWO DIFFERENT FR. TOGETHER TO GET TWO MORE THE SUM AND THE DIFFERENCE - THE DIFFERENCE IS THE I.F. OR LOW FR. FOR AUDIO. ZERO BEAT TWO EQUAL FR.

C.W. DETECTOR WILL OSCILLATE TO PRODUCE 2 FR.



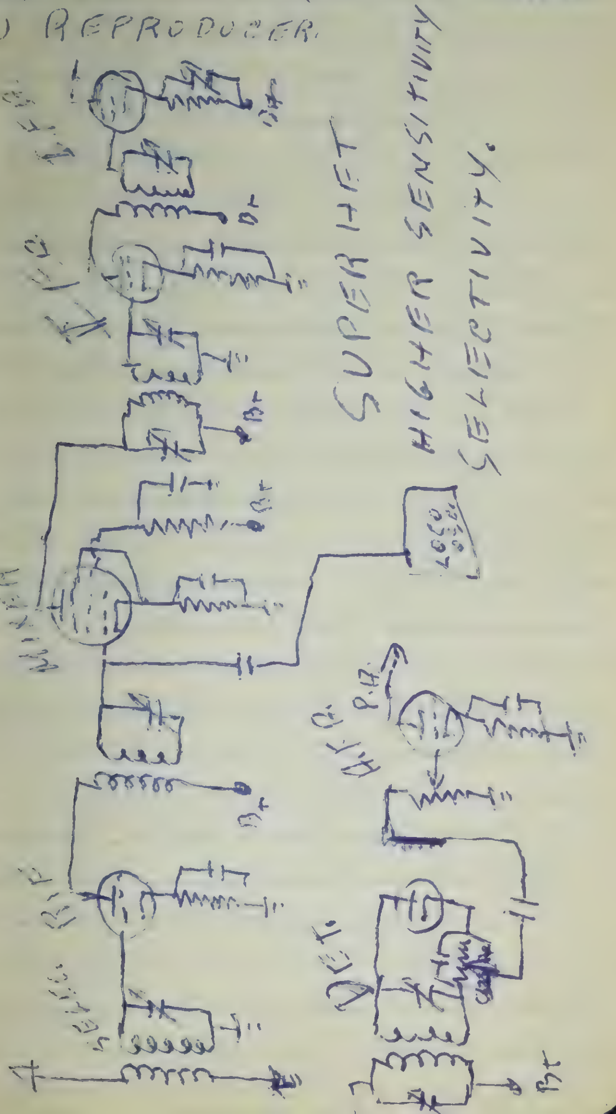
TO MIX WITH THE I.F TO GET A LOW AUDIO FR.

GENERAL RECEIVERS
TYPE T.R.F



T.R.F. MORESTAGES OF R.F. COULD BE USED
TO ADD [illegible] TO T.R.F. [illegible]
GOOD SENSITIVITY - GOOD AMPLIFICATION
EXCELLENT FIDELITY

URPOSE OF RECEIVER
1 SIGNAL INTERCEPTION -(2)
SELECTOR -(3) R.F AMPLIFIER
(4) DETECTOR (5) A.F AMPL.
) REPRODUCER.



SUPERHET. RECEIVER

LOCAL OSCILLATOR PRODUCE A FREQU. HIGER THAN INCOMING FR. TO MIX AND PRODUCE THE DIFFERENCE OR I.F. LOCOL OSC. FR. INJECTEC IN THE MIXER. ANY GRID CAN BE USED BUT INJECTOR GRID INJECTION THERE LOCAL OSCILL. FR = INCOMING + I.F. - I.F IS CONSTANT. TUNING CAPACITORS IN R.F MIXER AND LOCAL OSCILLAT ARE GANGED TOGETHER

FR. CONVERSION IN MIXER OF 1ST CONVERTER.

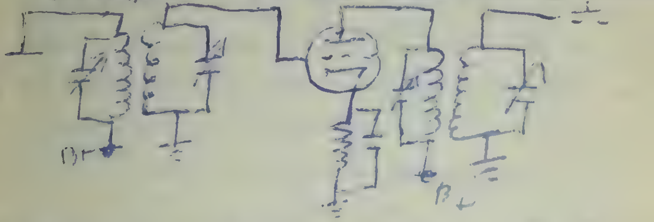
INTERACTION WHEN ONE STAGE AFFECTS ANOTHER. STAGE CONVERSION GAIN VERY SMALL FROM THE MIXER CONVERTER

I.F AMPLI. B.F.O & XTAL FILTER

I.F TUBE PENTODE VARIABLE MU - REMOTE CUT OFF - CATHODE BIAS & A.V.C BIAS CLASS "A" - A LOT OF SELECTIVITY DUE TO TUNED CKT IN INPUT AND OUTPUT - LOW STABLE I.F - SENSITIV HIGH AMPLIFI. CAPA. IN I.F ~~FIXED~~ ADJUSTABLE NOT VARIABL

TRANSFORMERS IN R.F. LOW NUMBER OF TURNS FOR HIGH FR. - IN I.F HIGH NUMBER OF TURNS - LOW FREQUEN.

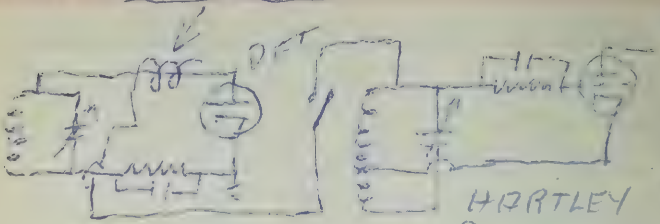
DOUBLE TUNED COUPLING

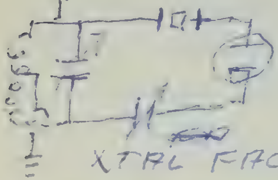


TWO WAYS OF TUNING I.F. (TRIMERS) ADJUST: CAPACIT. PERMIABILITY - IRON SLUGS IN COILS - MORE SELECTIVITY LESS TURNS OF WIRE IN COIL LESS RESIST. HIGHER "Q" OF CKT.

C.W. RECEPTION - I.F 455 Kc TOO HIGH FOR AUDIO DETECTOR CAN'T PICK IT UP NEED B.F.O. - B.F.O PUTS OUT FR OF 456 Kc. THE DIFFERENCE IS 1 Kc. AUDIBLE. CKT MUST BE HIGHLY SELECTIVE. NARROW B.W. USE XTAL VERY STABLE. WITH A SWITCH - NO GOOD FOR A.M XTAL WILL NOT PASS THE SIDE BANDS.

B.F.O FR. COUPLED TO DETEC-
TOR BY CAPACITOR COUPLING
OR GIMMICK





SPURIOUS RECEPTION AND INTERFERENCE: IMAGE FR. AND SPURIOUS RESPONSES.

IMAGE FR. AND UNDESIRED FR. HETRODYNING WITH LOCAL OSCILL. FR. PRODUCING THE RECEIVER I.F.

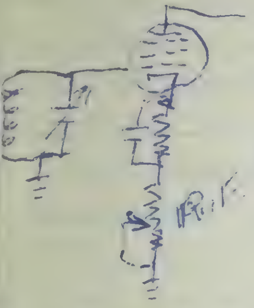
IMAGE FR. FORMULA:
DESIRED FR + 2 x I.F. OR LOC. OSC. + I.F. CAUSES FOR IMAGE FR - POOR OR IMPROPER SELECTION - USING LOW I.F. TO REDUCE IMAGE FR ADD R.F AMPL. OR HIGHER I.F.

FR, SELECTION AND SENSITIVITY

PRE-SELECTOR R.F. AMPL.

TUBE PENTODE - VARIABLE "MU" REMOTE CUTOFF, CATHODE BIAS - CLASS "A" - SENSITIVITY (AMPLIFIER).

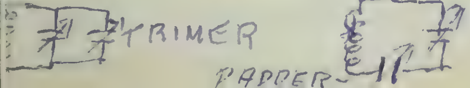
SENSITIVITY CONTROL OR R.F. GAIN CONTROL. TUNING CAPACI. SAME VALUE THAN I.F AND LOCAL OSC. COILS DIFERENT. SAME IN R.F AND I.F. OSCILL. DIFFERENT.



R.F. GAIN CONTROL VARIES THE AMPLIFICATION BY VARYING THE BIAS

TRIMERS CAPACI. ARE SMALL APACI. ADJUSTED IN HIGH END OF THE BAND IN PARALEL WITH TUNING CAPA. LOW VALUE

PADDER CAP. IN OSCILL. IN SERIES WITH TUNING CAPA. IN OSCILL. AND ADJUST. TO LOW END OF BAND - HIGH VALUE



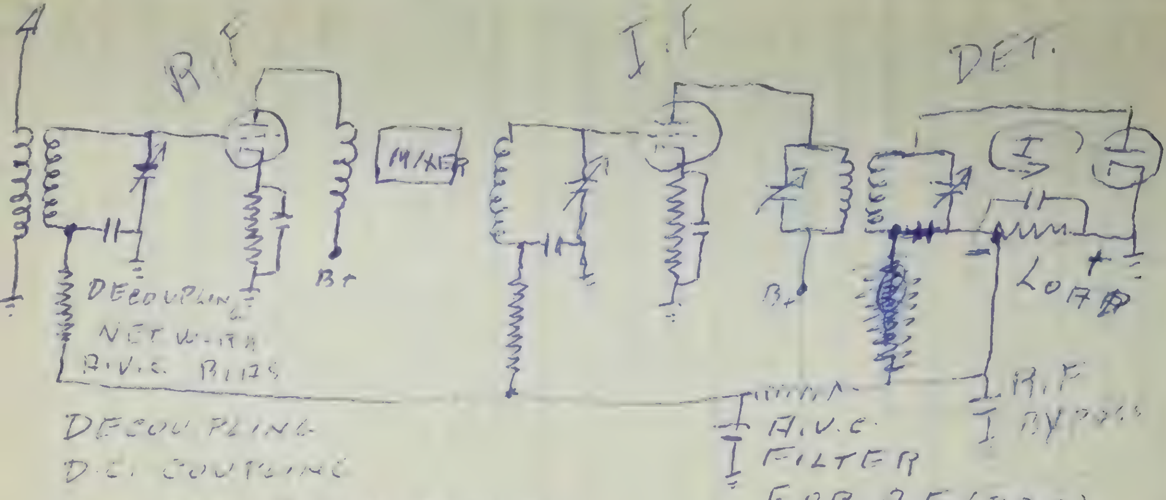
TRACKING IS ALL THE TUNED CKT ARE RESPONDING TO THE CORRECT FR. TRIMERS AND PADDER ARE TO HELP TRACKING. BIAS ↑ AMPLIF ↓

R, F ~~GAIN CONTROL~~

A.V.C. SYMPLE AND DELAYED A.V.C PURPOSE TO KEEP THE OUTPUT LEVEL OF RECEIVER CONSTANT, BY VARING THE NEGATIVE BIAS IN THE R.F AN I.F STAGES WITH THE STRENGTH OF THE SIGNAL. WHEN SIGNAL IS STRONG WE WANT STRONG NEGATIVE BIAS TO CONTROL AMPLIF. AND VICEVERSA SIG ↑. BIAS ↑ AMP, ↓. WE GET A.V.C BIAS FROM DETEC, TORD. SYMPLE A.V.C. NOT VERY GOOD. OPERATES ON STRONG AND WEAK SIGNALS THERE FOR IT CUTS DOWN THE WEAK SIGNALS. A.V.C. NEEDED FOR STRONG SIGNAL ONLY.

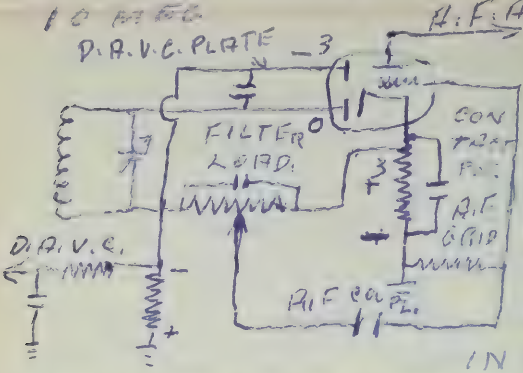
SYMPLE A.V.C.

CKT ⟶



DECOUPLING
D.C. COUPLING
R. FOR GRID RETURN
ALSO

DELAYED A.V.C. AND ALLOW AMPLIF. OF WEAK SIGNALS.
CONTACT BIAS



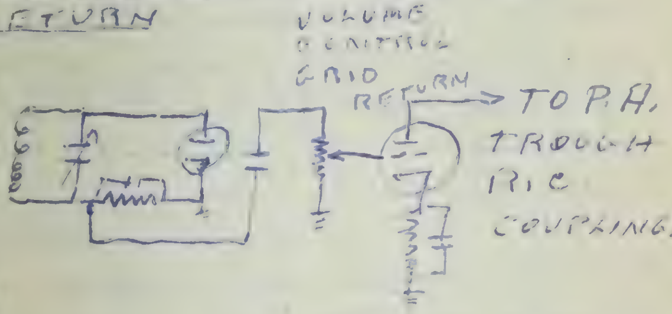
COUPLING CAPACITOR BETWEEN PLATES TO PUT R.F. SIGNAL IN D.A.V.C.

~~WHEN STRONG SIGNAL~~

WITH A -3 POTENT. IN D.A.V.C. PLATE WEAK SIGNALS THE DETECT. PLATE CONDUCTS MORE POSITIVE PLATE. WHEN STRONG SIGNAL APLIED THERE IS A POSITIVE POTENT. IN D.A.V.C. PLATE I FLOWS PUTTING A NEGATIVE POTENT. IN D.A.V.C. LINE FOR GRIDS OF R.F AND I.F. STAGES. THE OTHER SECTION OF TUBE IS A.F. AMP. FOR ALIGMENT OF SET SUTT OFF A.V.C.

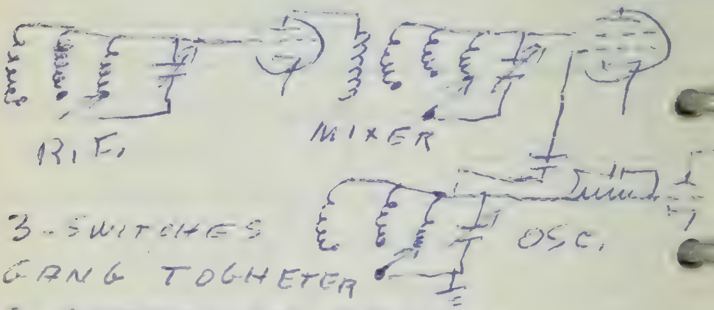
R.F. AMPL. (VOLTAGE) AND VOLUME CONTROL. THE R.F. VOLTAGE AMPL. NEEDS GOOD FIDELI. CLASS "A". TRIODE TO AMPLIFY OUTPUT AUDIO

FROM DET. (P.D.C).
VOLUME CONTROL TO CONTROL
HE AMOUNT OF AUDIO SIGNAL
VOLTAGE. TAP IN THE
EFT SIDE OF LOAD R. WE
ET AMPL. DUE TO GETTING
THE SIGNAL BEFORE IT
PASSES TROUGH THE R. COULD
BE USED AS A VOLUME CONTROL
WITH A POTEN. GRID RES-
TOR ALSO USE AS VOLUME
ONTROL.
2 KINDS (1) VARY OUTPUT
F DET. (2) VARY GRID VOLTA.
O A.F. AMP. CONSTANT POTEN-
IAL BIAS 10 MEG R. GRID
RETURN



A.F. POWER AMPL. AND REPROD.
P.A. IS LAST STAGE - BEAM
POWER TUBE OR PENTODE
N PUSH PULL - CLASS "A" CATHO
DE BIAS. TRANSFORMER
COUPLING STEP DOWN.

IMPEDANCE MATCH: R.C.
COUPLING GOOD F. RESPONSE
NOT GOOD FOR POWER.
REPRODUCERS (SPEAKERS
TYPES (1) MOVING IRON
ABSOLITE. (2) MOVING COIL
(3) PERMANENT MAGNET
MOVING COIL USES OUTSIDE
VOLTAGES TO EXCITE FIELD
OF COIL.
INCREASING THE TUNING
RANGE. = BAND SWITCHING
PURPOSE TO MAKE RECEIVER
CAPABLE OF WIDE RANGE
~~OF~~ RECEPTION - TWO TYPES
(1) ROTARY SWITCH DIFFERENT
COILS IN TUNED CKTS.



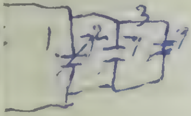
3-SWITCHES
GANG TOGHETER
3-CAPACITOR GANGED
2 TYPE PLUG IN COILS
SAME AS CKT. BUT NOT
SWITCH. PLUGIN TYPE
COILS.

BAND SPREAD PROCESS

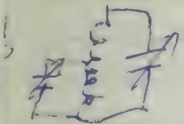
= SPREADING OUT A SMALL SECTION OF THE BAND CALLED - BERNIER TUNING TO MAKE TUNING EASIER

NO MECHANICAL - BY SMALLER TUNNING WHEEL.

ELECTRICAL TYPE ~~ONE~~ ~~AN~~ TUNING CAPACITOR VERY SMALL VALUE IN PARALELL WITH MAIN TUNNING CAPAC. OR IN PARALELL WITH COIL



1- MAIN TUNNING
2- TRIMER
3- BAND SPRED



COIL

ALIGMENT AND ALIGMENT EQUIPMENT:

(1)- SIGNAL GENERATOR RANGE 100 KC TO 32 MEG.

(2) · OUTPUT METER ~~W~~ VTVM CONECT ACROSS SECONDARY IN OUTPUT TRANS. SET FOR A.C. (3) ALIGMENT TOOL - PLASTIC SCREW DRIVER OR BAKELITY

ALIGMENT PROCEDURE

(1) TURN SET ON - (2) DYNAMIC TEST - (A) CONECT WTVM. IN OUTPUT. (B) SET GENERATOR TO 400 KC AUDIO APLIED TO GRID OF A.F. AMP. SECONDARY METHOD - GRID TAPPING - NO ADJUST MADE IN AUDIO STAGES.

(3) ALIGM. OF I.F. SEC. SET GENER. AT I.F. & MODULATED - KILL A.V.C KILL LOCAL OSC. APLY SIGNAL TO GRID OF LAST I.F. FOR MAX. READING ADJUST TRIMER IN SECONDARY OF OUTPUT MOVE TO PRIMARY AND REPEAT. MOVE TO NEXT I.F AND REPEAT. MOVE SIGNAL TO MIXER - ADJUST TRIMERS IN OUTPUT - CHECK LOCAL OSCIL.

R.F. STAGE SET GENERATOR TO 1600 KC MODULATED. PUT LOCAL OSC. IN OPERATION SET DIAL IN HIGH END OF BAND RECEIVER - APLY SIGNAL TO ANTENNA - ADJUST TRIMERS IN R.F. AND MIXER - NEXT DIAL TO

500 KC. LOW END OF
BAND - ~~ADJS~~ ADJUST
PADDER CAP. ON OSC. FOR
MAXI. RECHECK
TROUBLE SHOOTING (1)
READ OPERATORS REPORT
(2) VISUAL INSPECTION
EXTERNAL INSPECTION
FUZES - POWER CORD -
INTERNAL INSPECTION
LOOK AT COMPONENTS -
BURNED RESIST. - LOOSE
WIRES - TUBES - (3)
CONTINUITY CHECK - OHMMETER
CHECK RESIST. CHECK FOR
OPEN ~~CKT~~. CAP. (4) VOLTAG-
E MEASURES. - SET ON
(A) D.C. - B+ - LINES. A.C.
FILAMENTS - INPUT.
TEST EQUIPMENT
TOOLS - PLIERS - SCREWDRIVER
TL-13 - 8" LONG - DIAGONAL
NOSE TL-103 - LONG NOSE
TL-126 -
TEST EQUIPMENT - AMMETER
TO MEASURE CURRENT. USE
RESIS. IN PARALLEL FOR RAN
GE. VOLTMETER RES. IN SERIES
FOR RANGE. OHMMETER - SERIES
- SHUNT FOR HIGH & LOW RESIS.

V.T.V.M. TS 294/U - MULTIMETER
297/U. - RANGE 0 TO 1000 MEG.
MULTIMETER - 100 K OHMS.
TUBE TESTER I 177 DYNA
MIC - MUTUAL CONDUCTANCE
AND EMISSION TYPE. TO TEST
TUBES. (1) ~~SHORTS~~ LINE
BRIGHT. (2) TEST SHORTS.
SIGNAL GENERATOR - A.M.
I 72 - 3 TYPES OF OUTPUT
UNMODULATED R.F. ~~OUTPUT R.F.~~
~~FOR RECEIVER SECTION~~
OSCILLATOR. SECTION OF RECEIVER
MODULATED R.F. FOR I.F. + R.F.
SECTION. 400 CPS AUDIO
TONE FOR A.F. SECTION.
USED FOR ALIGNMENT - SIGNAL
SUBSTITUTION - CHECK GAIN
OF STAGES. CHECK TUBES
FR. METER - B.C. 221 +
SCR. 211 (ACCESSORIES)
125 TO 20,000 KC. RANGE
F.M. SIGNAL GENERATOR.
SG-13/U. BEST METHOD FOR
TEST TUBES IS SUBSTITUTION
BEST TESTER DYNAMIC.
THEORY OF THE D'ARSONVAL
MOVEMENT MOVING COIL TYPE
METER - PARTS HORSHOE
PERMANENT MAGNET --

VING COIL WOUND IN A
UMINUM FRAME. HARD STEEL
LETS TO SUPPORT THE COIL
WITH JEWELED BEARINGS
POLE PIECES TO CONCENTRATE
THE FLUX. TWO LIGHT SPRINGS
TO CONTROL THE POINTER
MADE OF PHOSPHOR BRONZE
CARRY CURRENT TO COIL
A LIGHT COIL SO IT CAN
MOVE FREELY. COUNTER WEIGHT
BALANCE THE POINTER.
VEMENT OF COIL DEPENDS
UPON THE NUMBER OF TURNS IN
COIL. CURRENT THROUGH IT
AND MATERIAL TO DETERMINE
THE AMOUNT OF FLUX IN
MAGNETIC FIELD. DAMPING
GET QUICK CURRENT READINGS
WITHOUT VIBRATIONS. CAUSED
BY HIGH EDDY CURRENTS IN
ICED IN THE ALUMINUM FRA-
ME - INTERNAL RESIST
DEPENDS ON AMOUNT OF WIRE
USED IN COIL - MORE WINDINGS
N COIL LESS CURRENT NEEDED
FOR FLUX. MORE RESIST.
SENSITIVITY OF MOVEMENT THE
AMOUNT OF "I" TO CARRY THE
POINTER TO FULL SCALE DE-

FRACTION. <u>FORMULA</u> - $R = \frac{E}{I}$

OR $R = \frac{1\ \text{VOLT}}{I\ \text{SENSITIVITY}}$

<u>OHMS PER VOLT SENSITIVITY</u>

NUMBER OF OHMS THAT MUST BE PUT IN SERIES WITH METER TO MEASURE 1 VOLT. AMOUNT OF RESIST. DETERMINES THE SENSITIVITY - LARGE RES. MORE SENSITIVITY. <u>VTVM</u> <u>11 MEG</u> INTERNAL RESIS. VERY SENSITIVE.

<u>AMMETER ANALYSIS.</u> A SHUNT RESISTORS WITH MOVEMENT OF METER, TO DIVERT THE EXCESS "I" AROUND. TO PROVIDE A PATH FOR "I" WHEN MEASURING LARGER CURRENT THAN METER CAN READ - R. MUST BE LOWER THAN INTERNAL R. OF METER TO INCREASE RANGE OF METER. LOWER ~~RES~~ SHUNT RES. PROPORTIONALLY. FORMULA TO FIND AMOUNT OF RESIST.

$$R_{\text{SHUNT}} = \frac{R_{\text{MET}}}{N-1}$$

WHERE R.MET. IS R. OF METER AN "N" IS THE TIMES METER GOING TO INCREASE RANGE (RATIO) NEW RANGE OVER OLD.

WHEN THE VALUE OF

E "N" IS OVER 50 DISRE-
GARD THE MINUS 1. POWER
FACTOR MUST ALSO BE CON-
SIDERED WHEN USING SHUNT
RESISTORS.

VOLTMETER - ANALYSIS

AMMETER WITH A HIGH
RESISTOR (MULTIPLIER) IN
SERIES WITH METER TO LIMIT
THE AMOUNT OF CURRENT (D.C)
FLOWING THROUGH IT. FORMU-
LA TO FIND VALUE OF MULTI-
PLIER. $R = \frac{E}{I}$ WHEN VALUE
OF RESISTANCE OF METER IS
LESS THAN 1% OF TOTAL 'R'.
DISREGARD. IF MORE SUBTRACT
IT FROM TOTAL 'R'. ~~THE SENSI~~
~~[illegible]~~ SENSITIVITY
OF VOLTMETERS IS OHMS
PER VOLT $= R = \frac{1 \text{ VOLT}}{I \text{ SENSITIVITY}}$

TO INCREASE RANGE INCREA-
SE RESISTANCE IN SERIES.
TO USE VOLTMETER FOR A.C.
USE RECTIFIERS - TWO HALF
WAVE OR A BRIDGE RECTIFIER
~~SELENIUM~~ COPPER OXIDE
DISADVANTAGES OF SELENIUM
RECTIFIERS - NOT VERY ACCU-

RATE DUE TO CAPACITANCE BETWEEN PLATES - ABOUT 5%

WRONG METER LOADING IS WHEN THE METER DRAWS TOO MUCH I FROM CKT DUE TO HIGHER METER R. - PUTS "R" IN PARALLEL WITH CKT. SO TOTAL R. DECREASES - NO VOLTAGE DROP TO READ. MORE R IN CKT MORE OVERLOAD.

OHMMETER TO MEASURE ACTUAL RESISTANCE. AND CHECK CONTINUITY - (1) DC METER (2) BATTERY (3) 'I' LIMITER RESIST (4) VARIABLE RESIST ZERO ADJUST. SERIES AND SHUNT TYPE. IN SERIES TYPE METER IS IN SERIES - WE ADD RESISTANCE IN SERIES FOR LESS I FLOW. POINTER DEVIATES TO THE LEFT. SERIES TYPE MORE ACCURATE IN HIGH RESISTANCE.

SHUNT TYPE METER IN PARALLEL WITH "R" BEING MEASURED. TOTAL R DECREASES. MORE ACCURATE IN LOWER RESISTANCE

TO TEST P.R. DISCONECT
ONE END OF RESIS. VTVM
USES BOTH SERIES & SHUNT
VTVM ANALYSIS USES
METER AND VACUM TUBES
VERY SENSITIVE - ABLE
TO READ VERY SMALL
VOLTAGES - ELECTRICALLY
RUGED - CAN'T BURN OUT
TUBE SATURATION - GREA
TER FR. RANGE - GREATER
[illegible] -
THE RESIST OF METER
MUST BE 10 TIMES THAN
R. OF CKT. (METER 11 MEG)
VOLTAGE BEIN MEASURED
CONTROLS THE Ip FLOW
THROUGH THE GRID OF TUBE
RANGE OF VTVM A.C.-D.C.
[illegible] 1000 VOLTS. RESIST
1000 MEG.
TUBE TESTERS TWO TYPES
EMISSION AND DYNAMIC
EMISSION TYPE TO TEST
THE EMISSION OF TUBE
ALL GRIDS OF TUBE CONNECTED
TO THE PLATE OF [illegible]
TUBE. SIMPLE NOT TOO
MANY PARTS - STURDY
SHOWS CONDITION OF CATHODE

DISADVANTAGES TUBE NOT OPERATING PROPERLY IN CKT. - THE DYNAMIC - [illegible] MUTUAL CONDUCTANCE OF TUBE (GM)

$GM = \frac{\Delta I_p}{\Delta E_p}$ RATIO OF CHANGE OF I_p TO E_g - MORE RELIABLE -

SUBSTITUTION PUTS TUBE UNDER WORKING CONDITIONS

TUBE TESTER I-177

"A" & "B" CONTROL SOCKET FILS. PUTS RIGHT FILAM. VOLT. RED BUTTON - AMPL. MICROMHOS ABOVE IN 3000 - TOP SCALE "L" CONTROL - PLATE VOLTAGE. "R" CONTROL GRID VOL. TWO REDS BUTTONS - STAND AND 224 - DIODE - 6A5S 1-2 - - LINE ADJUST TO HAVE 93 VOLTS ACROSS PRIMARY OF TRANSF. FIRST TEST FOR SHORTS. (2) QUALITY TEST READ - RED OR GREEN - MUTUAL CONDUCTANCE READ MHOS SCALE EMISSION TEST TO RECTIF & DIODES TEST D.C. PLATE CURRENT - RED AND GREEN FOR READ.

TUBES & AMPLIF. SECTION
MULTIPURPOSE TUBE.

GAS TEST - WARM UP FOR 15 MINUTE. ADJUST "L" TO GM OR EO - PRESS GAS NO 1 ADJUST R TILL READ 1000 MMHOS PRESS NO 2 GAS SEE IF POINTER MOVES UP IN SCALE MORE THAN HALF OF DIVISION NO GOOD TOO GASY DUE TO IONIZATION IP INCREASES. NOISE TEST TO DETECT INTERMITENT SHORTS.

SIGNAL GENERATOR I-72 TO GENERATE AND R-F SIGNAL WITH ENOUGH STRENGTH FOR TESTING PURPOSES. TYPES OF SIGNAL MODULATED R.F - UNMODULATED R.F - 400 CPS AUDIO TONE - MAXIMUM OUTPUT IS VOLTAGES OF SIGNAL USES ALIGMENT - SIGNAL SUBSTITUTION - CHECK TUBES

SIGNAL GENER. I-72 - MODULATE R.F 30.000 MICOVOLTS 400 CPS R.F. 1.5 VOLTS

OVERDRIVE OF STAGES WHEN TO LARGE OF SIGNAL

APPLY. VARY OUTPUT TO PREVENT OVERDRIVING AND DISTORTION. R.F RANGE 100 TO 32000 KC 2 CONTROLS TO VARY OUTPUT - 5 BANDS (1) 100 - 320 KC (2) 320 - 1000 KC (3) 1 MEC - 3.2 MEC (4) 3.2 - 10 MEC (5) 10 MEC - 32 MEC.

FREQUENCY METERS

A WAVEMETER WHICH CONTAINS A TUNED CKT WHOSE RESONANT FR. IS MADE EQUAL TO AN UNKNOWN FRE. PURPOSE TO HAVE A ~~N~~ ACCURATE FR STANDARD USES TO CALIBRATE EQUIPMENT - CAN RECEIVE AND SEND R.F. B.C 221 ~~??~~ SCR. 211 ACCESSORIES BATTERY - WEARES OUT BULKY LOOSE OF VOLTAGE FR. CHANGES - HETERODYNE TYPE - RANGE 125 TO 20 000 KC. 2 BANDS HIGH & LOW - 125 - 2000 KC. LOW - ~~FR.~~ FUNDAMENTAL FR. 125 - 250 KC HARMONICS 2 - 4 - 8 . LOW BAND

HIGH BAND. 250 - 500 KC
FUNDAMENTAL FR. HAR-
MONIES - 2-4-5.

CORRECTING CONTROL TO
CORRECT ANY DEVIATION
OF THE V.F.O. (ELECTRON
COUPLE HARTLEY) XTAL
OSCILL. PUTS OUT 1000 KC
CONTROL OF V.F.O. IS
SEAT WHERE WE REACH
ZERO BEAT - CONTROL
IN XTAL OSC. XTAL OSC
DETEC. & AMPL. - CONTROL
IN XTAL CHECK - BOTH OSCI.
CONTROL IN OPERATE - V.F.O.
DETEC - AMPL. THE HEARD
ET COMPARATE THE
FILAM. CKT. — DON'T CONN.
OUTPUT OF TRANSMITTER
TO ANTENNA - HIGH R.F.
SIGNAL GENERATOR TO
ANTENNA AND CHASSIS
CALIBRATION BOOK - ME - 122
INTERPOLATION - XTAL
CHECK POINTS AT BOTTOM
LEFT HAND CORNER OF PAGE.
TO FIND UNKNOWN FREQ
DIAL SETTING IS THE PROCESS
OF INTERPOLATION
EXAMPLE

FIND FR. WITH DIAL SET OF 3775.4 - LOOK IN BOOK AND TAKE READINGS ABOVE AND BELOW

3776.1 — 3606 kc
3775.4 — X
3773.7 — 3605 kc

$$\frac{2.4}{1.7} \quad X = \frac{1}{X} = \frac{1.7}{2.4} = .7$$

SUBTRACT AND CROSS MULTIPLY AND INVERSE RESULT FOR DIVISION

ADD RESULT TO LOWER FR.

3605 + .7 = 3605.5 X FR.

TO CALIBRATE SIGN. GENER.

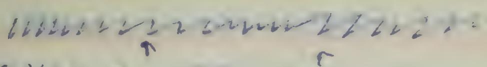
WARM UP FOR 15 MINUT. - PLUG IN HEAD SETS. COUPLE GENER. TO ANTENNA. - CHECK V.F.O. IN XTAL CHECK FOR ZERO BEAT - SWITCH TO HET. OSCILL. SET GENER. TO APPROXIMATE SAME FR. AND ZERO BEAT AND CHECK DIAL FOR CALIBRATION OF GENERATOR.

INTRODUCTION TO FM SIG. GENERATOR 56-12/U. FOR ALIGNMENT OF FM EQUIPMENT

IN FM. THE INTELLIGENCE IS MODULATED IN THE

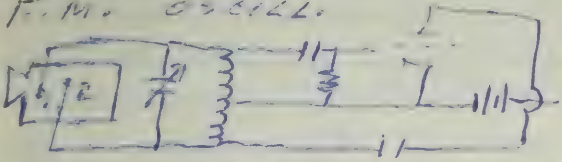
VARIATIONS OF THE FR.

A.M. 

F.M. 

VARYING FR.

F.M. OSCILL.



FR. IS MODULATED BY THE NE/PLATE (VARIABLE) OF MIKE CHANGES CAPACITANCE WITH STRENGTH OF SOUND THERE FOR CHANGING FR.

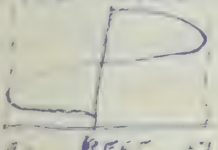
PLATES CLOSER - CAP ↑ FR. ↓

PLATES FARTHER CAP ↓ FR ↑

OUTPUT OF OSCIL. IS VARYING RF AND AUDIO RATE.

REST FR IS THE CARRIER FR. WITHOUT MODULA.

DEVIATION MAXIMUM AMOUNT OF CHANGE OF FR. ABOVE OR BELOW REST FR. - DEVIATION DEPENDS ON THE STRENGTH OF THE MODULATED SIGNAL



SWING OR B.W. IS TWICE DEVIATION CHANGE ABOVE AND BELOW REST FR.

PITCH OR SPEED OF MODUL. SIGNAL DETERMINES FR OF MODUL. SIGNAL

OUTPUT OF SG-12/U

3 SIGNALS.

1- R.F. MODULATED F.M.
2- R.F. UNMODULATED
3- I.F. UNMODULATED.

RANGE - 20 - 102 MEG.

20 - 20,000 CPS POSIBLE IN MO-
DULATION. R.F. OUTPUT .005 TO
10,000 MICROVOLTS. I.F. XTAL
CONTROL, FOR CALIBRATION
CONTROL 20 TO 60MC. EVERY
1 MEGACYCLE - FROM 60MC TO
102 MC. EVERY 2 MEGACYCLES.
ZERO BEAT DEVIATION FROM
0 - 100 KC. HAS THERMOSTAT
HEATER TO KEEP V.F.O. AT
OPERATING TEMPERATURE.
DIAL FOR FR. TO METHODS
DIRECT CONTROL IN LINE
R.F. SET TO RED LINE.
FIND FR. IN DIAL LOWER
SCALE, THIS METHOD NOT
VERY ACCURATE. R.F. UNMO-
DULATED INDERECT METHOD.
USE INTERPOLATION - SET DIAL
1 MEGACYCLE ABOVE FR. AND
ZERO BEAT. TAKE READING
OF TOP SCALE AND VERNIER
AND PUT TOGETHER MAKE
A 4 FIGURE NUMBER

SET DIAL ONE MC. BELOW FR. - ZERO BEAT AND TAKE READINGS EXAMPLE -

FIND READING FOR 52.68 Mc.

53	— 1424	
52.68	— X	1358.72
52	— 1220	

$$\frac{1}{.68} \times \frac{204}{1} = \frac{138.72}{1} = 138.72$$

1220 + 138.72 = 1358.72

BC 342 PURSE [illegible]

AN/GRC-26 P.T- <u>100</u>	F.M. THEORY P.T- — <u>100</u>
AN/PRC 6-10 LAB- 93 P.T- — 97 AVE — <u>94</u>	AN/TRC- P.T — 95 LAB- 88.5 CARRIER — 100 AVE - <u>91</u>
AN/GRC-3-8 PART-I R.T- 108 {RT-70 AM-65 P.T — 95 LAB- 92 AVE- <u>93</u>	PART II R.T- 66 CONTROL- P.T- — 93 LAB — 93 AVE - 93
RADIAC - P.T — (?) LAB— (?) AVE - 80.2	MAC-20 AIRCRAFT P.T. — 91 LAB — 95.5 AVE — 94

D.C.
TEST - 88
LAB - 100
AVE 92

A.C.
TEST - 96
LAB - 100
AVE - 97

TUNED CKT
TEST - 80
LAB AVE. 90
AVE - 83.3

TUBES
TEST - 94
LAB AVE - 92
AVE - 94.3

POWER SUPLY
LAB - 93
TEST - 92
VE - 92

[illegible]
LAB - [illegible]
TEST - 96
AVE - 94

T. REC.
TEXT - 100
LAB - 93
AVE - 97

TEST EQUIPMENT
TEXT - 100
LAB - 88.8
AVE - 92.5

B.C. 342
TEST - 95
LAB - 95
AVER - 95

B.C. 191
TEST - 95
LAB - 95
AVE - 95

AN/GRC-9
TEST - 100
LAB - 94
AVE - 96

SCR-499 - B.C. 610
TEST - 100
LAB - 85
AVE - 90

The ability of the secondary load to control current flow in the secondary

Reflected Impedance

1° Test — 96

2- Lab — 100

3. Final average — 97

RELUCTANCE - OPPOSITIO

L - INDUCTANCE - ABILIT

Ω - REACTANCE - OPPOSITION COIL

IMPEDANCE - TOTAL R. Ω

C - wf - Mega

L - wh

C - wf Kilo

L - mh

C - f

L - h

1/20 cycles

COS 5/80

FLUE WITH

WITH

FLOW 3.14

$\sqrt{21,16}$

0516

60

516

WHITH

WITH

$\sqrt{2,50}$

150

amplifisuo